SCIENTIFIC AMERICAN

The European Infantryman's Rifle
The Bullets of the Fighting Nations
Machines for Treating Wounded Soldiers
How the Allies' Ships Were Sunk in the Dardanelles

Vol. CXII. No. 18
May 1, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

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The too Heavy car dollar

The Chalmers dollar

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Go to the nearest Chalmers dealer's and look them over.

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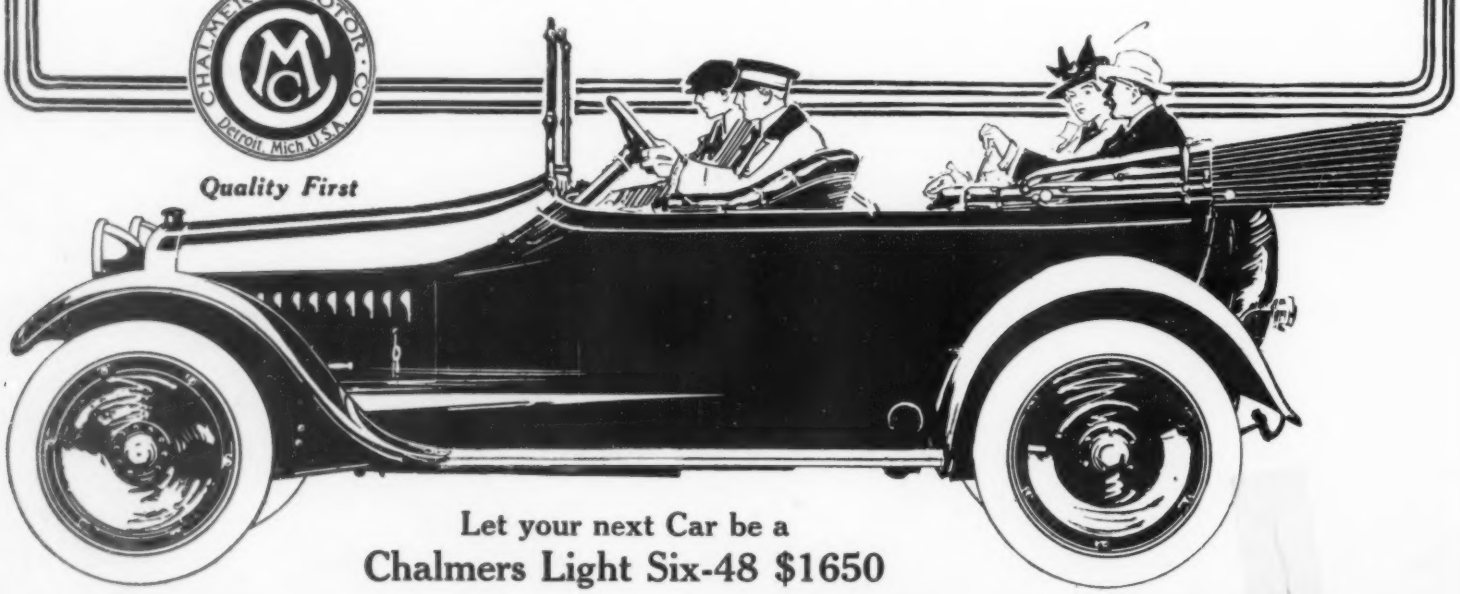

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THE

70th Anniversary

NUMBER of the

Scientific American

June 5th, 1915

THE Scientific American was founded seventy years ago, at a time when the United States of America was industrially less developed than South Africa at the present time. Even territorially, it was not the same country we know now; for California, Texas, and the great Southwest belonged to Mexico.

During that long period of seventy years the Scientific American faithfully chronicled the technical and industrial progress which we Americans made. Its editors saw the advent of the reaper, the telegraph, the telephone, the great trans-continental railways, the laying of the transatlantic cable, the development of the giant steamship, the perfection of the phonograph, the glow of the first electric incandescent lamp, the coming of the motion picture machine, the miracles wrought by wireless telegraphy, and more recently the conquest of the air.

What an age of wonders it has been! What a transformation has been wrought upon the face of the earth! Surely no tale of the Arabian Nights, no fantasy of Jules Verne depicts marvels so amazing as those which the Scientific American has been the first to describe authoritatively as soon as they appeared. Who would have thought, seventy years ago, that with the aid of the X-rays we could look through a man's body; that friend could talk with friend from New York to San Francisco; that Niagara Falls would illuminate cities; that street cars would move magically through our towns without any apparent means of propulsion; that pictures would be sent by wire from New York to Chicago, and that by means of the boundless ether a solitary passenger ship on a desolate ocean still keeps in touch with civilization.

It has been the privilege of the Editors of the Scientific American to know the men whose master minds have wrought these things, and to hear from their own lips the story of their struggles and their triumphs. Ericsson, Morse, Edison—the whole dynasty of inventive genius which has made the nation what it is—the editors have known them all.

Seventy years is a turning point not only in the life of a man, but in the life of any enterprise. It seems fitting that the occasion should be commemorated by the publication of a number which will review the progress that the United States of America has made in the three-score years and ten of our existence.

In June a number will appear which the Editors hope will do full justice to the great theme of American invention—a number which will transport us all back to the time when our fathers and our grandfathers still burned candles, when horses pulled street cars, when there were no automobiles and when the steam railway was a curiosity that people would travel miles to see. The motion picture machine of industrial progress will be turned backward, and the flickering film will make you wonder what the future will have in store if so much that is wonderful has happened in the past.

MUNN & COMPANY, Inc.

WOOLWORTH BUILDING NEW YORK CITY

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This is to settle Truck Tire claims in a quick and a final way. Arguments don't settle things, and comparisons are costly.

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The S-V will win for these reasons: It gives you 20 per cent more available tread rubber. It gives you a shape which ends bulging, breaking or excessive grind. It gives you a compound which saves undue friction, taxing tire and power.

It gives you a tire which can't creep. It is pressed on at a minimum of 50,000 pounds, without an auxiliary fastening.

It gives you an inseparable tire. By a secret process, the tread, the backing and the rim are welded into lasting union.

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S-V Truck Tires

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2355

SEVENTY-FIRST YEAR

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THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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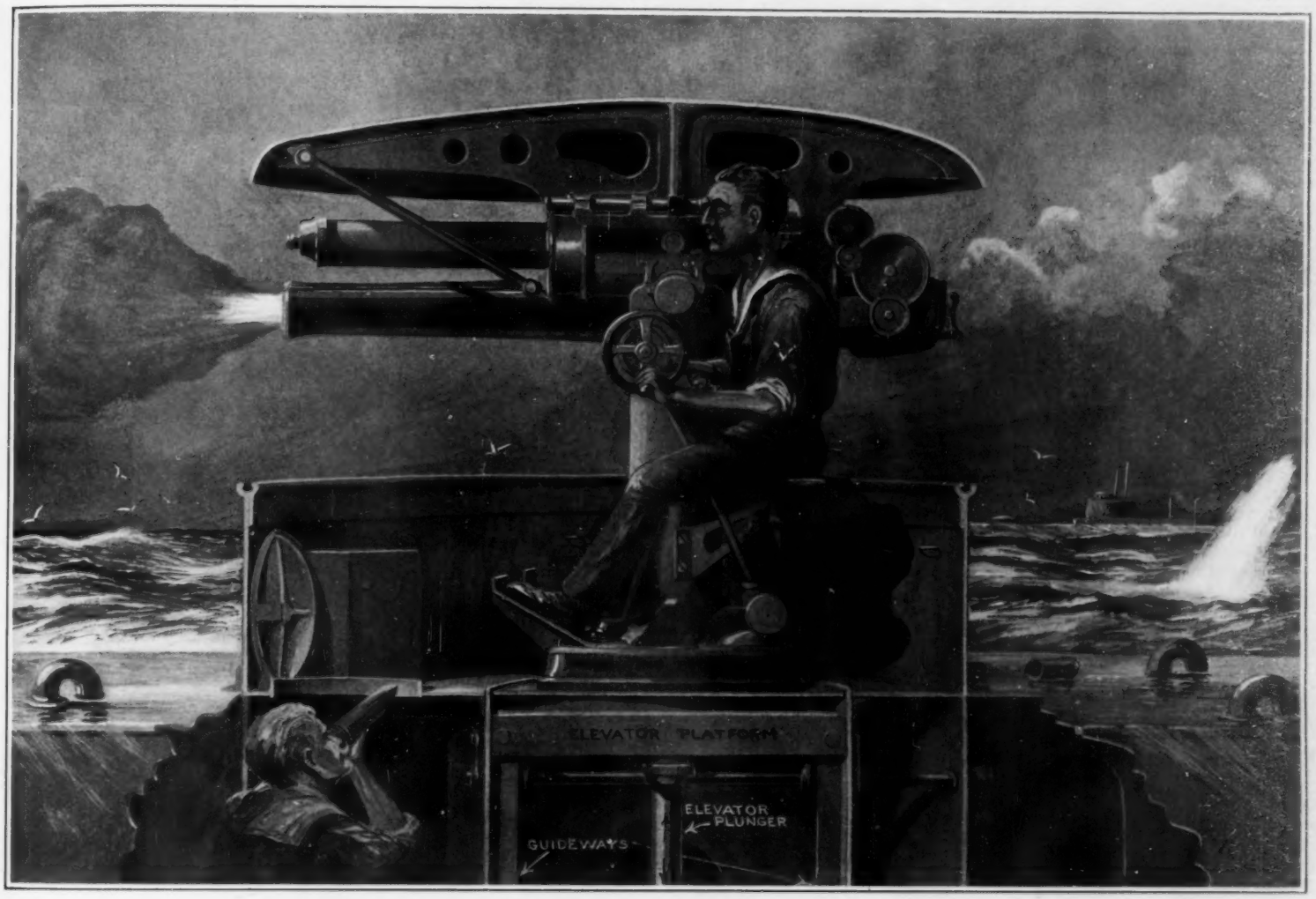

Disappearing guns which it is reported are used on German commerce-destroying submarines.

The Submarine as a Commerce Destroyer

THE submarine in the role of a commerce destroyer has proved a surprise to the military world, and the Germans have again scored through their initiative. But it was inevitable that this method of attack would prove too expensive if hits were to be made by the torpedo alone. The merchant craft of the allies were not slow in realizing the limitations of the under-sea boat when relying upon the mechanical fish as a weapon of destruction, and many have been the instances where zigzagging and full speed have made it possible for the ship of trade to dodge the oncoming torpedo.

Latterly, the U-boats have been halting their quarries by means of gunfire and then have blown them up, after abandonment, by dynamite charges planted aboard where they would be likely to sink the merchantmen quickest. But this order of procedure has now become impracticable because of the greater alertness of the flotillas of British and French destroyers. Accordingly, the Germans are now sending the traders to the bottom by gunfire alone in many instances, and this method of attack is far more formidable than has hitherto been believed possible on the part of submarines. Its present climax is extremely significant, for it heralds a new stage in the offensive development of the under-sea boat.

It is a matter of common report that the German submarines that figured prominently in the early months of the war were equipped with two sorts of guns. One a 37-millimeter weapon firing from a fixed pedestal mount a shell of 1½-inch caliber; and the other, a more formidable piece, arranged to disappear into the superstructure and to throw a 12-pound projectile. This gun is a stumpy, but powerful rifle, having a caliber of 2.95 inches, and at moderate range likely to prove an unpleasant antagonist for a torpedo boat. But again this meant exposure for the gun's crew, for the men had to come out upon the deck in plain sight if the submarine were running light, as she would of necessity have to be, to measure forces in this fashion with a surface fighting craft. To get under suddenly, the deck hatch might have to be closed before the men at the gun could retreat into the submarine.

On the 29th of March the "Crown of Castile," a British steamer, was sunk off the Scilly Islands by the German submarine "U-28," and she was sent to the bottom, according to her crew, by shell fire. But this attack, so it is reported, was not made by 12-pound projectiles, but by shell of 4-inch caliber. The 4-inch gun fires a shot weighing in the neighborhood of 33 pounds, and surely this marks an important advance in artillery for submarines. The "Crown of Castile" tried to outdistance her pursuer and to zigzag away from torpedoes, but the German commander not only had superior speed to draw upon, but he had also a surprise in the shape of this newest of under-water-boat guns. Now this development confirms a rumor of recent months that the Kaiser's submarines were being supplied with bigger guns and that these weapons were installed in a novel manner, in fact, so mounted that they would not be continually exposed to the corrosive action of salt water when the craft were running submerged. Further, the arrangement was such that the gun crews did not have to stand upon the open deck.

We are able to illustrate, from a reliable source, the housing, gun and mount, which is said to be identical with that employed by the Germans in their very latest and largest U-boats. It is quite manifest that the installation is a long stride forward in making the submarine more formidable and efficient, especially when used as a commerce destroyer or when called upon to put up a fight against the worst of her present foes, the high-speed sea-going torpedo boats. More than that, the arrangement shelters the gun crews from aerial attack. The particular installation which we are able to show is that for a quick-firing 14-pounder, but the operative principles would be the same for heavier weapons, such as the 4-inch rifles which we are told some of the U-boats now carry.

The gun, with its superposed recoil cylinder and sheltering hood, is mounted upon a revolving pedestal provided with seats for two operators—one controlling lateral movement and the other manipulating the elevating gear with his left hand and firing with his right. The revolving pedestal, in its turn, is supported by a plunger elevator functioned by means of a pneumatic cylinder. The gun-hood is really the hatch cover, and when the weapon is lowered this cover is seated watertight against a rubber gasket in the recess at the top of the hatch or barbette. The gun pointers take their positions when the elevator is lowered, and rise with the rifle when the hatch cover lifts and the gun is cleared for action. The piece can be elevated and lowered in a few seconds.

It is perfectly plain that an installation of this character adds in fact and potentially much to the military powers of a submarine. Because guns of this sort can be worked in the semi-light trim a submarine need not expose so much of her hull or superstructure and, accordingly, should be able just so much quicker to seal up and disappear below the waves for greater security. It is equally evident that a disappearing mount of this nature can be housed beneath and within protecting armor of moderate thickness and a frontal shield set upon the gun, thereby greatly increasing the resistance against attack. In this we can see the first step in an evolutional line which will blaze the way to the still larger sea-going submarine with its upper works in mail,

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Munn & Co., Inc., 233 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Scientific Solidarity in Wartime

IN the annual report of the United States Weather Bureau for 1897-98 it is recorded, as a noteworthy example of scientific solidarity, that during the war between the United States and Spain the weather forecasters at Washington continued to receive regular meteorological reports by cable from the official Spanish observer at Havana. We cite this episode as an instance in which the spirit of international comity among scientific men (or was it exaggerated Spanish politeness?) appears to have been inconsistent with the demands of patriotism. Presumably the weather reports from Havana aided the American Government in the task of protecting its fleet from the West India hurricanes which might otherwise have proved valuable allies of the Spaniards.

In Europe, during the present war, the interchange of weather observations that prevails in time of peace has been suspended between belligerent countries, while the reports that are still exchanged between friendly countries are withheld from publication until they have ceased to be of more than academic interest. The fact that German meteorologists no longer receive cabled weather reports from the British Isles is said to have been directly responsible for the wreck of the two Zeppelins in Denmark last February.

It is evident that men of science—unless they throw patriotism overboard altogether—must curtail their habitual relations with their colleagues in a hostile country in time of war, but it does not follow that these relations must be completely abandoned, even for the time being; much less that future relations should be embittered by intemperate acts and words during the period of hostilities.

The European war will not last forever. When it is over, intercourse will necessarily be resumed between the scientific men of all the countries now embroiled. There are many scientific enterprises that absolutely depend upon international co-operation, and there is no branch of science in which such co-operation is not helpful. Will not many European *savants* then have cause to regret the gratuitous slurs they are now casting wholesale upon the science of the enemy? This campaign of vituperation has been, in some quarters, as actively carried on as the military and naval operations.

We are glad to learn that a few, at least, of the co-operative scientific undertakings in which the belligerent countries are participators have not been seriously disturbed by this senseless war. The work of the International Latitude Observatories goes on as usual; the German regional bureau of the International Catalogue of Scientific Literature continues to send bibliographic material to the central bureau in London; and the members of the International Commission on Zoological Nomenclature still record their votes as in time of peace.

Radium as a Fertilizer

A TIMELY bulletin has just been published by the Illinois Agricultural Experiment Station, at Urbana. In it Messrs. Cyril G. Hopkins and Ward H. Sachs report the results of two years' field trials of radioactive substances applied as fertilizers, and also discuss the general question of crop stimulation *versus* soil enrichment.

After reviewing the contradictory results thus far obtained in properly controlled experiments regarding the effects of radium on plant growth—a subject which has already produced a voluminous literature—the writers point out that "efforts are being made to add radioactive substances to the list of commercial fertilizers and stimulants that farmers are urged to buy," thus bringing the subject well within the purview of the State experiment stations, whose activities are not prompted by commercial motives. An analogous situation exists with respect to radioactive waters, the alleged therapeutic virtues of which have received careful attention from the U. S. Public Health Service.

The substantially negative results obtained in the experiments at Urbana will not surprise anyone familiar with previous experiments of the same character as reported in the scientific journals, rather than in the newspapers and the popular magazines. We need not dwell upon this feature of the bulletin, but we think it opportune to record the stand taken by the authors against attempts at crop stimulation in general as an ordinary agricultural practice.

Assuming radioactive fertilizers to be effective and dependable—which apparently they are not—the authors argue that "the effect would be that of a stimulant and the increase in crop yields would be secured at the expense of the soil. Thus the soil would not be enriched in fertility, but actually impoverished by such treatment."

This argument applies also to the still problematical methods of electroculture, and even to the practice of excessive cultivation by means of extra deep tillage, either with subsoil plows or with dynamite.

"Even if such practices were temporarily profitable, they might not be advisable, because they tend to make soils poorer, and the same expense in limestone, phosphate, clover, or manure, which are highly profitable on our common soils, would tend toward positive soil enrichment and permanent preservation of fertility."

This is an important point, and one that has been almost universally overlooked. We believe, however, that there is another side to the question; for there are cases in which the advantages of forcing a crop in order to secure an early yield more than offset the disadvantages of a temporary depletion of the soil. Radioactive fertilizers and electrocultural processes will have their legitimate use whenever they become practical—if they ever do.

The Beginning of a New Epoch in the Motor Truck Industry

CLOSE observers of the motor truck situation in this country have been noting several tendencies of late which seem to portend an entirely new epoch in this industry—one that seems destined to have a far-reaching effect on the whole system of manufacture, sale, and maintenance of commercial motor vehicles. This change is being brought about entirely through economic causes, apparently, and will do much, it is believed, to offset some of the unsound conditions which have been more or less of a disturbing factor to the best growth of the industry ever since its inception.

To realize fully just what this change is and what its causes are, one must go back and note how the commercial motor vehicle business actually began and how it has developed through its short span of years.

The motor truck industry really had its beginning as a sort of side line to the pleasure car business. The early manufacturers found that there was a demand for light commercial vehicles which they could readily supply by merely fitting their standard chassis with lower gear ratios and putting on special commercial types of bodies. In consequence of this development from the touring car, the same salesmen usually served for both lines, and not until very recent years has the commercial end been thoroughly divorced from the pleasure vehicle line.

Pleasure car salesmen naturally did not probe very deeply into the traffic problems of their prospects. They were chiefly interested in getting sales regardless of whether or not their customers could properly care for and maintain their trucks after purchase. Even with the later system of selling through trained salesmen who make a more careful analysis of each customer's requirements and particular transportation problems, there is still a tendency to "load up" merchants with motor vehicles, who, economically speaking, cannot use or maintain them advantageously. The successful maintenance and use of commercial vehicles calls for skillful handling, proper repairs and upkeep, and careful, systematic management. A thorough observance of these requirements can only be secured by employing competent, skilled drivers and mechanics as well as providing a proper equipment for the maintenance and repairing of the vehicle. Failure to carry out these obligations often makes the otherwise most useful motor truck a veritable "white elephant" on its owner's hands.

Now, in order to successfully meet these necessary qualifications, the small motor truck owner (who has one or two vehicles only) must do one of two things. He must either employ one good driver-mechanic to care for his machine and also own or rent proper garage facilities, or he must pay some garage for its repairs, storage, and maintenance. In either instance his expenses are likely to be considerably out of proportion to the trucking facilities received, for in one case he really maintains equipment and skilled labor sufficient for a much larger number of vehicles than he actually uses, and in the other he must pay regular garage rates with the repairman's profit added.

The question therefore naturally arises, Would it not be better for the small motor truck user, if, instead of attempting to purchase and maintain vehicles of his own, he rent them from a trucking company either regularly or by the trip? Wouldn't he really save money, to say nothing of escaping the worries and troubles of trying to maintain one's own transportation equipment? There are indications that not only the small users but also the manufacturers themselves are beginning to see the light and are rapidly coming to an affirmative conclusion in the matter.

From the manufacturer's standpoint, there is no question but that the present system of marketing commercial vehicles and keeping their owners satisfied is both wasteful and detrimental to the best development of the industry. The very fact that the small truck user will not, because economically he really cannot, properly maintain his vehicles, has forced the manufacturers to provide expensive free repair service, through branches and traveling representatives, at ruinous cost.

The large user can afford to own his trucks outright and properly maintain them because the necessary equipment and skilled labor cost is divided over several vehicles. Therefore, the free inspection and service of the manufacturer was not created primarily for him but for the small user, but he naturally takes advantage of it just the same, to the further discomfiture of the manufacturer. If this expensive feature of the manufacturer were to be cut off entirely, the big user would not give up his trucks, because to him they are not only economically practical, but well-nigh indispensable to his business. The small user is, therefore, the thorn in the flesh that is driving the manufacturer to tackle the problem from another angle, i. e., on the rental basis.

Theoretically, the advantages of the rental system appear very attractive both for the small user and the manufacturer. As far as the former is concerned, he should receive adequate motor-trucking facilities at considerably less cost than at present. His time and attention could be devoted strictly to his business, aside from the regular oversight of his traffic, schedules, routes, etc. He could secure a truck of proper capacity for each particular load instead of, for instance, trying to make a three-ton truck carry a five-ton load, as is likely to be the temptation under the present conditions, and he would be saved a considerable investment in rapidly depreciating equipment.

On the manufacturer's side there should be a lessening of the free service cost, for large centralized trucking companies would be fully as capable of caring for themselves as large private owners. The selling cost would be reduced because of the narrowing of the prospect field. At first, doubtless the more effective use of all vehicles under centralized trucking management might reduce the total sales somewhat, but the lower costs which such a system would make available should bring more customers, and consequently more demand for trucks.

Whether this development along rental lines will come in the form of subsidiary companies or branches of the manufacturers themselves or as separate organizations is of minor importance compared with the sound economic features of the movement in general. That it is destined to play an important part in the future of the motor truck business seems evident, and it would appear to be slowly evolving as a necessary step in the advancement of this important industry toward a firmer and broader foundation.

Canopus, the Center of the Stellar Universe.—The last number of *L'Astronomie* is chiefly devoted to the subject of "the giant sun Canopus." Though somewhat less bright than Sirius, on account of its vastly greater distance from us, Canopus is much the larger star. Its volume is supposed to be 2,420,000 times that of the sun, and its brilliancy 49,700 times. Walkey's computations seem to show that Canopus actually occupies a central position in the stellar universe, as we know it. The sun is credited with a distance of 489 light-years from this central luminary, around which it is said to describe an orbit the plane of which is inclined at an angle of 20 degrees to the plane of the galaxy. The sun's last periastron passage is stated to have occurred 6,950,000 years ago. The whole subject is, of course, highly speculative.

Electricity

Albert Medal Awarded to Marconi.—The Albert Medal of the Royal Society of Arts, England, which is awarded annually for distinguished merit for promoting arts, manufactures, and commerce, was presented to Guglielmo Marconi this year. The medal was instituted in 1863 when the Prince Consort was president of the society.

Electric Drive in a Paper Mill.—A paper mill at Maumee, Ohio, reports a saving of $400 a month as a result of the introduction of electric drive. Previously this mill operated with steam power, using two 100-horse-power boilers. Now in place of being driven from long lines of shafting, the machines are individually driven by motors. Not only has this resulted in a direct saving of power, but it has been found possible to reduce by two men the regular force of workmen.

A New Alternating Current Fan has made its appearance in which variation of speed is obtained not by means of a rheostat, but by rotating the windings of the fan. The advantage of this is that the fan may be started at any position of the winding without danger of burning out by merely operating a push button. The energy that is consumed by the fan varies with its speed, which is not the case with the ordinary fan. When this fan is operating at full speed it takes 24 watts, and at the lower speed, it consumes about 7 watts.

Electric Air Brake.—Electric-pneumatic brakes are soon to displace the air brakes used on the passenger trains of the Pennsylvania Railroad. This form of brake has been found necessary because of the weight of trains made up of all-steel cars. In long trains the shock and surging accompanying the application of the brakes has proved very objectionable indeed. In a twelve-car train it takes eight seconds for the full braking force to be felt at the last car. With the electro-pneumatic brake, the braking power will be exerted at the same instant on all the cars, and within two seconds after the application of the brakes, the whole braking force will be exerted throughout the train.

Lamp Trimmers' Safety Signal.—Arc lamp trimmers frequently find it difficult to lower the arc lamp on a busy street without the danger of having the lamp crashed into by passing vehicles. The driver of a car is more apt to keep his eyes on the road than to look up, and sometimes the glare of the sun will prevent him from seeing a lamp that is hanging just high enough for his vehicle to hit it. Realizing this danger, a man in Minneapolis has devised a signal consisting of a tripod with two white signal wings on which red circles are painted. This the lamp trimmer places on the street under his lamp, and then he may lower the lamp without fear of a collision.

Cell Which Reverses Polarity When Illuminated.—In a paper read before the British Physical Society, Mr. A. A. Campbell Swinton describes a curious phenomenon in a galvanic cell having for one electrode a plate of zinc and for the other tinned copper, coated on one side with selenium and varnished with enamel over the remainder of its surface. When these plates are immersed in tap-water the galvanometer shows that in the dark the zinc is electro-positive to the selenium, but when light falls on the selenium the polarity is reversed. If in place of the zinc plate, a plate of carbon or copper is employed, then the selenium proves to be electro-positive in the dark and electro-negative when illuminated.

Edison Batteries for Submarines.—The disabling of the submarine "F-4" in Honolulu Harbor, the cause of which at present writing has not been ascertained, has led to the surmise that some trouble might have been experienced with the batteries. Should sea water have come into contact with the sulphuric acid of the batteries, chlorine gas would have been generated. Of course sulphuric acid is not the only electrolyte that need be used in storage batteries. The Edison battery, for instance, uses a potash solution which gives off no poisonous gases when coming into contact with sea water. Public interest in the Edison cell has been aroused particularly by the fact that the new submarine "L-8," which was recently launched, is equipped with this type of battery.

Tiny Motor for Dentists' Use.—An electric motor, even in small sizes, is quite heavy for the power it yields. For this reason dentists have been using a motor mounted on a bracket, and connected by a flexible shaft with the point of application of the power. Recently, however, a miniature electric motor has been devised for the dentist's use which is so small and weighs so little that it may be connected directly to the dental chucks and used as a hand tool, thus doing away with the cumbersome universal shaft. In place of the shaft a light electric cord connects the motor with a lamp socket. The motor is one of the smallest ever made for commercial use. Its weight is but 5¼ ounces, and it is 1¾ inches long by 1¼ inches in diameter. It uses only 12 watts and operates at a speed of 15,000 revolutions per minute. It can be used either on direct or on alternating current. A control switch is mounted on the motor where it can be operated conveniently by the hand. The speed of the motor may be controlled by a foot-operated rheostat.

Science

The Non-magnetic Yacht "Carnegie" started March 6th on her fourth cruise, which is expected to continue for two years. During the period November, 1915-March, 1916, an attempt will be made to circumnavigate the globe between parallels 60 and 65 degrees south latitude.

Sven Hedin, the distinguished Swedish explorer, has been excluded from honorary membership in the Royal Geographical Society and from the Russian Imperial Geographical Society, on account of his pro-German attitude in connection with the war. Both bodies will probably be heartily ashamed of themselves after peace is declared. Patriotism and science should not interfere with one another.

Is Arsenical Spraying Dangerous to Birds?—It has been commonly reported that arsenical spraying of trees in New England in order to eliminate the gipsy moth has proved fatal to many birds, but according to Dr. L. O. Howard, Chief of the U. S. Bureau of Entomology, investigations fail to show any such result. The absence of birds from the regions where spraying has been practised can be explained by the fact that the spraying causes a scarcity of insect food, and the birds are obliged to seek this elsewhere.

A Travel Course in Physiography is an interesting item in the programme of the forthcoming summer session of Columbia University. This course will take the form of a physiographic excursion to the western United States, conducted by Prof. D. W. Johnson, lasting about two months. The party will visit the Devil's Tower, Yellowstone National Park, Glacier National Park, Crater Lake, the Yosemite Valley, Royal Gorge of the Arkansas, the Pike's Peak region, and probably also Lassen Peak and the Lake Bonneville region. The start is to be made from New York in July.

Modern Piano Wire.—Supplanting the hard, high-tension strand of old, the piano wire in demand to-day for the highest grade instruments is tough and fibrous and of absolute uniformity, and when cut, it shows a clean, white steel. The piano makers have, by actual test, been brought to see that the softer wire has the greater artistic merit. The latter vibrates so evenly throughout, when actuated by the proper degree of energy, that a true fundamental tone results, with just enough of the octave to impart brilliancy, of the fifth to impart timbre and of the third and sixth to impart richness, and will be amplified by the sounding board.

The Rediscovery of "Nephritic Wood."—Mr. W. E. Safford recently addressed the Botanical Society of Washington on this subject. "Lignum nephriticum," or "nephritic wood," so called on account of its supposed medicinal properties, was obtained from Mexico and widely used in Europe in the sixteenth, seventeenth and early eighteenth centuries. It is constantly mentioned in the scientific literature of those centuries. An infusion of the wood in water produces remarkable fluorescence, and this phenomenon was observed by the Hon. Robert Boyle in the seventeenth century. In modern times this wood has been nearly forgotten; scarcely a fragment of it is now to be found in drug collections, and its botanical identity has hitherto been altogether uncertain. It is now identified as *Eysenhardtia polystachya* (Ortega) Safford. Mr. Safford exhibited specimens of the wood and botanical material, and Dr. Briggs, of the Bureau of Plant Industry, showed the fluorescence of its extract in the rays of an arc light.

Agricultural Atlases of the United States.—A notable undertaking of the Office of Farm Management, U. S. Bureau of Plant Industry, is a large agricultural atlas of the United States, to which several other branches of the Department will contribute. This work will be published, in the first place, in the form of a number of separate monographs, which will ultimately be combined to form the complete atlas. Pending the completion of the large work, a similar work on a much smaller scale, adapted for use as a school atlas of American agriculture, will be issued—probably this year. This will comprise about 100 pages of maps and diagrams, accompanied by a brief text. The maps will present the following subjects: Relief; soils; climate; crops (distribution, seed-time and harvest, etc.); live stock distribution; size, value and tenure of farms; rural population.

Public Education and Cancer.—The campaign for public education which is now being undertaken by the American Society for the Control of Cancer should be productive of good results if the experience of Germany is any criterion. The campaign originally initiated in eastern Prussia by Winter of Koenigsberg for the instruction of all people, but particularly of women, in the early symptoms of cancer explained the value of the earliest possible surgical and medical treatment. In this campaign the co-operation of the laity and the medical profession on the one hand and the press on the other was enlisted with excellent results. When the campaign was started in the early nineties the cancer death rate of Koenigsberg had increased from 53 in 1880 to 110 in 1893. The rate continued to increase up to 1907, when it reached a maximum of 139 per 100,000 of the population. Subsequent to that year the rate gradually declined to a minimum point of 118 for the year 1912.

Aeronautics

Invisible Aeroplanes.—Of late there have been made attempts to construct aeroplanes of a transparent material, at least for all purposes where a canvas covering is used at present, such as the wings and the fuselage. One of the latest ideas of the kind is said to be an aeroplane which uses un-inflammable celluloid for the wings and other parts, and when flying at a few hundred feet in the air the apparatus is quite invisible, according to reports. A new muffling box on the motor serves to deaden the sound. One advantage of the transparence is that observations can be made in all directions.

A Reaction Helicopter.—A patent has been granted to Alphonse Papin and Didier Rouilly of Paris, France, No. 1,133,660, for a Helicopter, the improvement being applicable to all helicopter machines. In the improved helicopter the propulsion is effected by the reaction obtained from jets of air blown into the atmosphere through orifices or nozzles in the helicopter, on the principle of the aeolipile, the single propeller or screw of the helicopter having hollow blades or wings and the screw carrying blower means to propel air through the hollow wings and out of the orifices.

Three Aeroplanes for the Navy.—It has been announced that the Secretary of the Navy is about to place an order for three hydro-aeroplanes with the Burgess Company, of Marblehead, Mass., at a contract price of $11,500 each. Bids had been asked for the furnishing of three or six machines, the award to be based on the completeness of the proposals, and the extent to which the designs conformed to or exceeded the requirements, and owing to the character of the bids it was decided to contract for only three machines at this time. This is the first contract placed since Congress appropriated $1,000 for aviation.

Panhard-Levassor Aviation Motor.—The new 100 horse-power type belongs to the class of light water-cooled motors, and its lightness is secured by a judicious grouping of the parts rather than by an exaggerated lightening of the pieces. The V-shape is here adopted, and there are two sets of 4 cylinders mounted on the crankcase at a 90 degree angle. Water cooling, which is common to each set of 4 cylinders, is noteworthy by the adoption of longitudinal cooling wings upon the water jacket, on the outer side, while the valves all lie on the inner side or next the top of the motor, being driven by a single cam shaft. Bore 4.4 inch by 5.6 inch stroke; speed 1,500 revolutions per minute; weight 440 pounds, which gives the weight per horse-power as 4.4 pounds.

Firing Between Propeller Blades.—A year ago—on April 11th, 1914—the SCIENTIFIC AMERICAN illustrated a machine gun firing over the tractor screw on a monoplane. A German patent has recently been issued describing a means of shooting through the disk area of a propeller. The trigger of the gun is geared to the engine so that when a blade is in the line of fire a lock prevents the gun from being operated. Roland Garros is said to have chased and brought down two Tauben recently by firing between his propeller blades. The difficulty of the operation may be judged by the fact that the normal speed of a Gnôme motor is 1,200 revolutions per minute. The builder of the Heinrich biplane also proposes to arm the machine with a gun firing between the blades of the tractor screw.

Two Hundred Horse-power Anzani Motor.—The latest Anzani motor is one of the most powerful that is in use for aeroplane work. It has 20 cylinders grouped around a circular crankcase, cylinder bore 4.2 inch and stroke 5.8 inch. Speed is 1,250 revolutions per minute. On this type there are used 4 groups of 5 cylinders, all cylinders being of the same size. On the barrel-shaped crankcase each group is spaced along so that the cylinders are staggered with reference to the other groups, but viewed from the front, the effect is a star with 10 fore cylinders and 10 rear cylinders, while the side view shows each of the four groups lying in a somewhat different plane. Two cranks are used on the shaft, No. 1 being operated by all the rods of 10 cylinders and No. 2 by the remainder. Weight of the Anzani motor is 682 pounds.

Stabilizing Apparatus for Flying Machine.—An automatic stabilizing apparatus, particularly of that class in which a pendulum is provided is shown in a patent No. 1,132,503, to O. Wittokowski of Dusseldorf, Germany, the object being to provide an apparatus which will not be injuriously affected by the inertia of the pendulum when the flying machine changes its velocity. In doing this the pendulum, which is designed for stabilizing the flying machine in a longitudinal direction, is provided with a plane or planes which have a rocking support on a transverse axis and are so connected with the body of the flying machine that they are set, when the body is inclined at a certain angle, at a corresponding angle in order that in each position of the body the forces acting on the same are at an equilibrium, such forces being the pull of the propeller and the resistance of the front faces of the body of the machine and the pendulum. Thus in operation the air resistance of the pendulum is varied according to the inclination of the body to the direction of flight.

The European Infantryman's Rifle

Comparison of Mausers, Mannlichers, Lee-Enfields, and Other Weapons Used in the War

By Edward C. Crossman

On the Whole the Great Military Powers Agree in the Demands They Make of the Service Rifle. England Seems to be the Worst Off, Because Her Troops Are Not Uniformly Armed

As Might be Expected the German Mauser is the Best Service Rifle Now in the Field. It has Been Adopted by Other Fighting Nations, Notably Belgium, Turkey, and Russia

THE British were caught in bad shape when the war broke out. They have clung to the old Lee action, taken up in 1889, and with many changes have used it ever since despite its weakness and the advent of better rifles. Evidently the hope of an automatic military rifle prevented them from disarming their troops of the old Lee and re-arming them with a better rifle, like the Ross or Mauser.

They now use the short Lee-Enfield in the regular army which is now on the Continent, a rifle using chargers of five cartridges something like the clip of the Mauser, for refilling the Mauser magazine. Only the British rifle, having a protruding box magazine, holds ten cartridges or two clips at a time, against the five of nearly all other rifles like the Mauser and its American brother, the new Springfield, a Mauser with some changes.

Unhappily the territorials, or "militia," as we would call them, have the older long rifle, giving different shooting, and of course a nuisance were two forces of the two branches fighting on the same line. Both rifles are inferior in strength and simplicity to the Mauser. The British had an experimental rifle finished and a few ready for experimental issue when the war broke—a Mauser firing the 0.280 cartridge much like the Ross. Of course, it cannot be used, not being beyond the experimental stage.

The British Mix Their Rifles and Ammunition.

Worse still, the British have a mixed lot of ammunition, and this might cause bad mixups in giving sight settings and calculating the fire of troops. The regulars on the Continent are using the Mark VII, a spitzer of 174 grains loaded into the same old 0.303 case, but giving 2,440 foot-seconds instead of 2,000, as did the old Mark VI, with blunt nose 215-grain bullet. This Mark VII is a fair cartridge, but there is not enough of it, and the British must fall back upon the Mark VI old style stuff, giving lower velocity; and worse than this, to be shot in rifles sighted and with sights graduated for the newer ammunition.

Take, for example, a regiment of the line, armed like the others with the short Lee, but supplied in the rush of a hot attack with the Mark VI or old ammunition. If the officers giving range and sight settings did not know and remember this and give a far higher sight setting to compensate for the lower speed of the old style stuff, the entire fire of this regiment would be wasted, because the bullets would strike the ground short of the mark. Mixed ammunition, like mixed rifles, is a frightfully bad thing in hard fighting.

The Mark VII is loaded with 40 grains of tubular cordite powder, a yellow, celluloid-like stuff that comes in tubes or sticks just the length of the shell space behind the bullet. A bundle of the sticks is pushed into the cartridge, then the neck is formed by machinery and the bullet seated in this neck.

The British have bought a huge number of the Japanese service rifle, a modified Mauser manufactured in Japanese arsenals, but fear to send them to the Continent because of the great complications they would add to the already hard problem of supplying the right ammunition for the various types of rifles their troops already are using. Unless a complete unit, such as a division, can be armed with these rifles, sending them over would merely add trouble. The Japanese rifle is 0.25 caliber; the British rifle is a 0.303.

Very evidently the British have been badly blistered by the work of the despised German sharpshooters, and they lay most of the efficiency of these men to their telescopic rifle sights.

A number of men in every German company of infantry are supplied with the fine prismatic telescopic rifle sights, and with these to aid them in picking up, and aligning the rifles upon almost hidden foes, they do murderous work in their sniping.

The British have finally resolved to meet them at their own game, and have placed large orders in America for telescopic rifle sights, depending mostly upon the makers of the telescope sight for the American army. In our own service the two best shots in each company of infantry are armed with rifles equipped with fine prismatic telescope sights, for just this sniping work.

On a well-lighted and defined objective, the telescope rifle sight offers no advantage to the man with normal eyesight, but in picking out a partly hidden or badly lighted mark, the telescope sight gives the rifleman the same advantage that a fine prismatic field glass gives the person using it. It is necessary merely to find the mark in the field of the glass, touch it with the needle point in the telescope field and squeeze the trigger.

The telescope mounted on the American service rifle, although not yet perfect, is probably the most carefully designed telescopic sight ever made. Short and compact, it is furnished with graduated elevating and traversing disks for the finest adjustments in range and windage. No other instrument of its sort approaches it, save the sighting telescopes used on field guns. Optically, it is hardly the equal of the German glasses.

The French "Lebel"—An Amusing Rifle.

The French use a rifle, the Lebel, that looks like the old wrecks sold in department and army sale stores, and labeled Veterli or something similar to it. It has a tubular magazine in the forestock like an American repeating rifle, the receiver is nickel-plated, and, all in all, it is the most amusing looking rifle of the whole collection. Its whole get-up looks crude and child-like. Add to this a fearfully long triangular bayonet, such as the American army discarded twenty years ago, give the soldier carrying it a long blue coat like an overcoat and a pair of red trousers, and you've got a picture to make the gods weak from laughter.

The cartridge is quite interesting, with its solid copper-zinc alloy bullet. Not satisfied with the virtues of the sharp point, the French went still farther, and put on a tapering stern on their bullet; so it is a true boat-shaped bullet, instead of being cut off square behind like all other bullets. Thus, the bullet is given a streamline form, which even German ballistic experts admit cuts down air resistance. It weighs 170 grains and it leaves the rifle with a speed of 2,400 foot-seconds. It is quite as good as the English cartridge. The magazine is loaded, not with clips or chargers like the rifles of the others, but by the slow process of cramming in one shell after another into a tubular magazine like an American Winchester's.

The Russians and Their Modified Mauser.

The Russians use a modified Mauser, with ammunition of the old blunt nose type like the British Mark VI, velocity 2,000 foot-seconds. The bayonet, a triangular one, is always fixed, is very hard to remove, and has no scabbard. It is carried on the rifle at all times—a very clumsy, crude and senseless scheme.

The Belgians use the Mauser, with ammunition of the older blunt nose type, clip-loading, like the rifles of all the nations save France. In this system a clip or charger of five cartridges is pushed into a slot at the top of the magazine entrance. A push of the thumb drives all five out of the clip, down into the magazine, and the clip is thrown away. The caliber, like that of the Russian and French rifles, is practically 0.30.

The Turks use the Mauser, of 0.30 caliber, and use to some extent the newer pointed bullets in this rifle.

The Austrians and the Germans are the best equipped of any of the nations in the rifle line. The Austrians use the Mannlicher, firing pointed bullets with a velocity of nearly 2,800 foot-seconds.

The New German Mauser—The Best in Europe.

The Germans use the latest type of Mauser, from which the American new Springfield was taken. The rifle, a clip-loader, weighs nine pounds. It fires spitzer bullets of 154 grains weight, with a velocity of over 2,900 foot-seconds. The rifle in its simple sight-setting arrangement, its finish, its accuracy, and the high speed of its bullet is superior to the rifle of any other nation among those fighting. It has a long sword bayonet, usually carried in a scabbard at the soldier's belt. With its long barrel and long bayonet, it gives a stabbing length of 5 feet 9 inches with the bayonet on, beating the others save the long bayonet of the Frenchman.

The German soldier has eight inches the better of the argument over the British soldier when it comes to crossing bayonets, and the extra eight inches easily turns the battle in favor of the longer, if both men are of equal skill.

The Japanese, in true Japanese style, a people who lift everything they fancy and make it without regard to the laws of patents or copyright, make a rifle that is a Mauser in the points that are good, terming it "Year 38." It fires a 0.25 caliber cartridge, with pointed bullet and a velocity of 2,900 foot-seconds.

The Canadians, in spite of being part of the forces of the British Empire, cast out the ancient and honorable Lee nearly ten years ago, taking the Ross, a rifle made by Sir Charles Ross of Scotland, in Quebec. Their present rifle, practically the rifle that sells on the American market for sporting use, fires the regulation 0.303 British army cartridge instead of the much better Ross product, the 0.280. This, of course, because of the necessity for using the same cartridge as the British troops.

This Ross is a straight pull rifle; that is, by an arrangement primarily like the familiar spiral screwdriver, the bolt with the locking lugs is revolved by pulling straight back on a bolt handle and separate sleeve, unlocking the bolt without the usual half turn of a bolt handle, as on the Mauser, Krag, new Springfield, and Lee-Enfield.

The Rifles of Austria, Bulgaria and Greece.

The same principle is used in the Mannlicher straight pull of Austria, Bulgaria, and Greece. This type of rifle action is very fast, a snap back and forth of the wrist being sufficient to operate it, but it is more tiring for a long series of shots because of throwing the strain on only one set of muscles.

All the other rifles use what is called the turn-bolt, a long cylindrical bolt containing striker and main spring, carrying an extractor on the head, and having two steel lugs to lock against the explosion, working back and forth in grooves cut in the receiver. The bolt is locked by turning it a quarter round to the right, revolving the lugs in behind shoulders in the frame; it is unlocked in the reverse direction, hence the name turn-bolt, as opposed to the straight pull rifles of Austria, Greece, Bulgaria, Switzerland, and Canada. The chief virtues of these rifles is the strength, the simplicity, and the impossibility of jamming the mechanism for more than a moment. All the essential parts can be removed for cleaning and repairs without tools.

This is true in the highest degree with the German Mauser, in the lowest with the French Lebel and the straight pull Mannlichers.

With these magazine rifles, fitted with magazines for charger loading, and having a wonderfully high rate of sustained fire, the problem is to keep the men supplied with ammunition for an all-day's hot battle. The Japanese troops went into some of the battles near the Yalu and later, carrying 350 rounds of ammunition per man. Yet some of the soldiers were out of cartridges by noon. The weight of 350 rounds of the Japanese 0.256 cartridge is, of course, 350 times the weight of each cartridge, this being 350 grains. Each soldier was therefore carrying, besides his regular pack and rifle, 17½ pounds of cartridges.

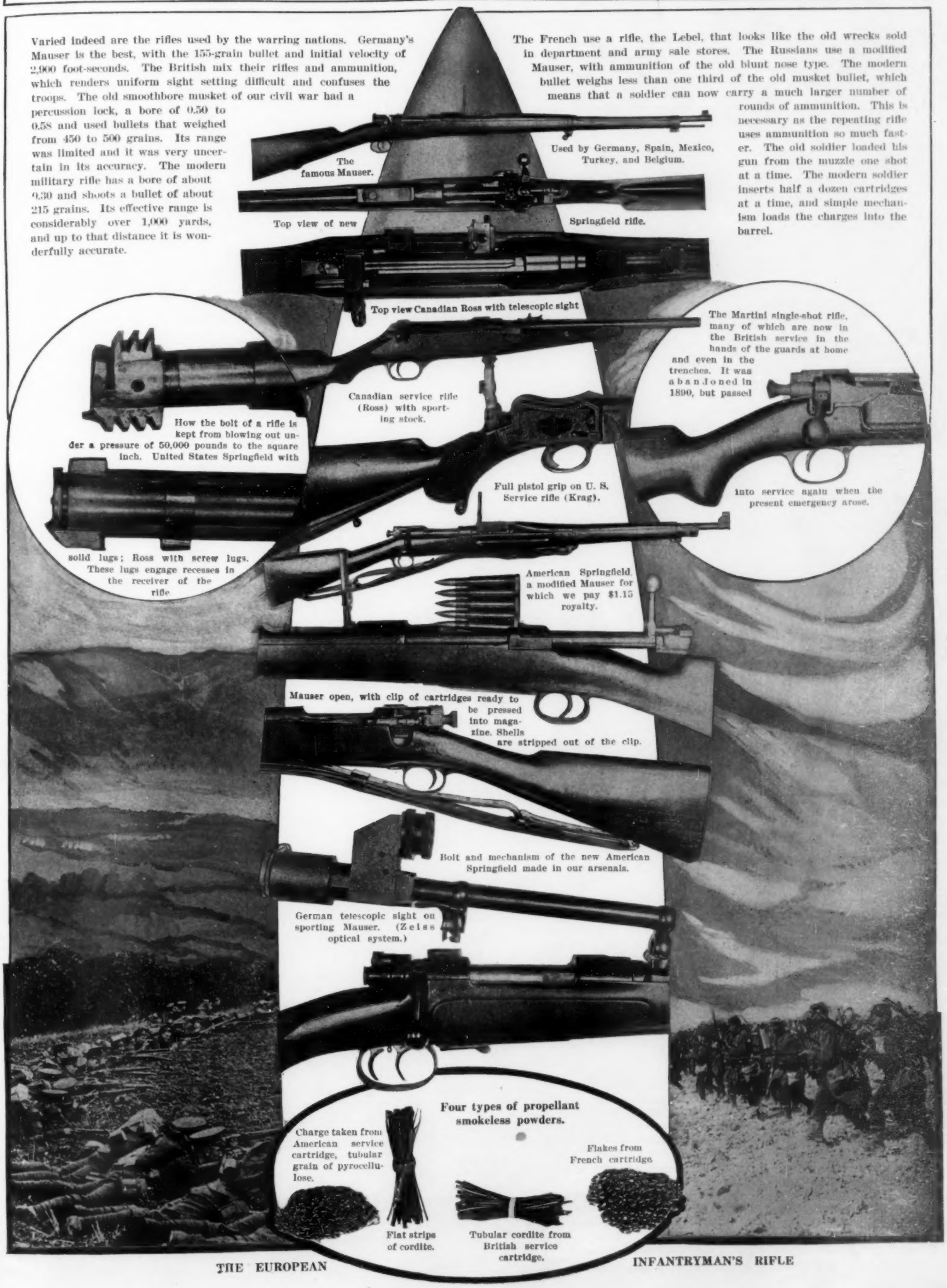
The British soldier, carrying as much, is still worse loaded down, because of the greater weight of his ammunition. Using the old type of Mark VI, to which he is probably reduced by this time, he lugs nearly 21 pounds if he takes in 350 rounds. With hasty trenches thrown within 400 yards of each other, as reported in one phase of the British fighting, there is very little time to replenish the supply on the firing line from the reserve store as is laid down by all good text books.

The Rifles of European Fighters

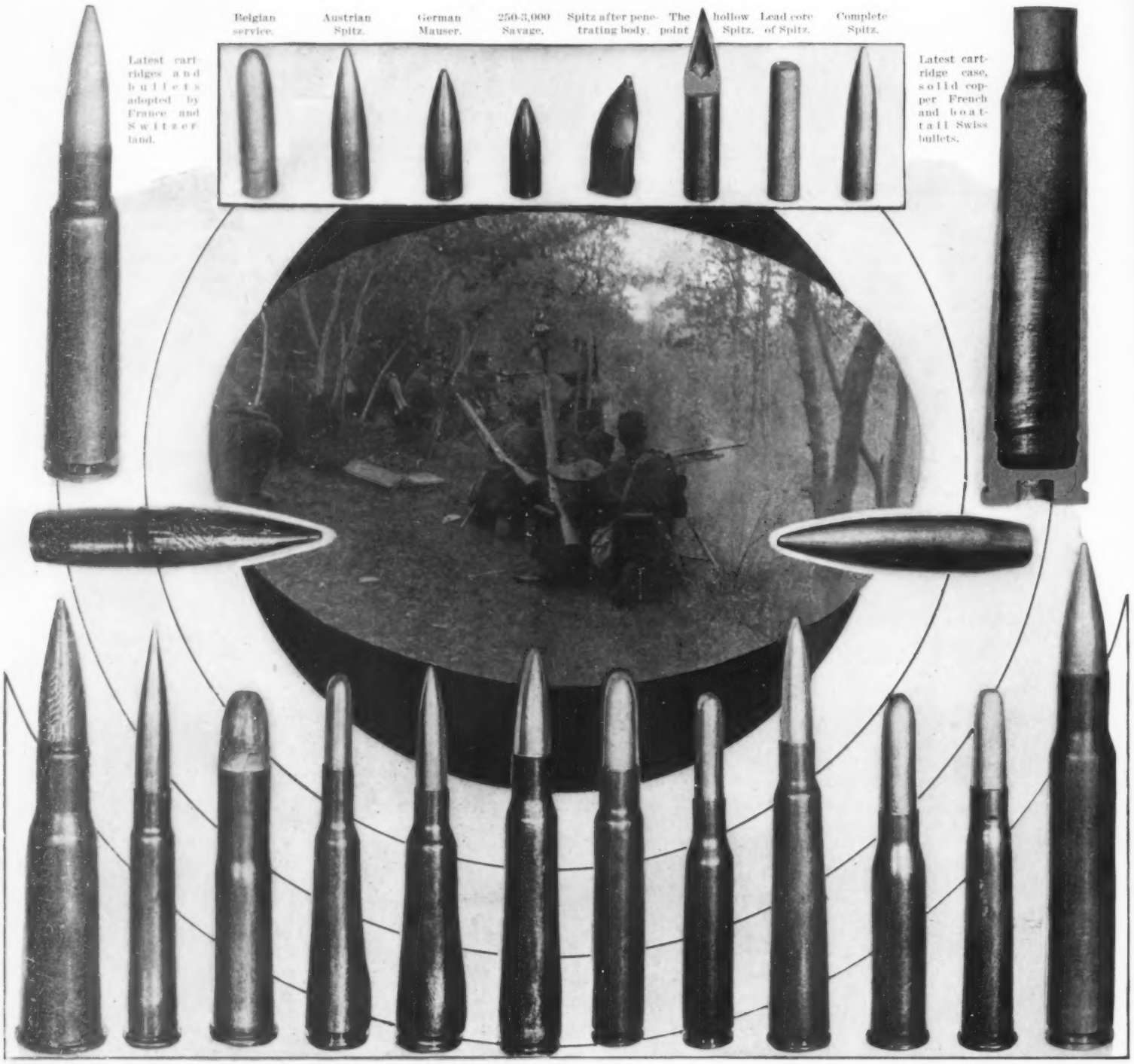
They Have a Range of 4,200 to 5,200 Yards, But That Is Not Their Chief Virtue. They Shoot Flat, Thanks to Their Sharp-Pointed Bullets, and Flatness of Trajectory Counts for More Than Range in Shooting

Varied indeed are the rifles used by the warring nations. Germany's Mauser is the best, with the 155-grain bullet and initial velocity of 2,900 foot-seconds. The British mix their rifles and ammunition, which renders uniform sight setting difficult and confuses the troops. The old smoothbore musket of our civil war had a percussion lock, a bore of 0.50 to 0.58 and used bullets that weighed from 450 to 500 grains. Its range was limited and it was very uncertain in its accuracy. The modern military rifle has a bore of about 0.30 and shoots a bullet of about 215 grains. Its effective range is considerably over 1,000 yards, and up to that distance it is wonderfully accurate.

The French use a rifle, the Lebel, that looks like the old wrecks sold in department and army sale stores. The Russians use a modified Mauser, with ammunition of the old blunt nose type. The modern bullet weighs less than one third of the old musket bullet, which means that a soldier can now carry a much larger number of rounds of ammunition. This is necessary as the repeating rifle uses ammunition so much faster. The old soldier loaded his gun from the muzzle one shot at a time. The modern soldier inserts half a dozen cartridges at a time, and simple mechanism loads the charges into the barrel.



THE EUROPEAN INFANTRYMAN'S RIFLE



The Bullets of the Fighting Nations

How the Shape of a Bullet Affects Its Flight

BACK in 1905 the Germans, prying around, as usual, in rifle experiments, re-discovered the ballistic fact that if you sharpen the bow of a bullet it cuts down air resistance, as sharpening the bow of a canal boat to a yacht bow cuts down the resistance of the water. Back in the 50's Col. Jacobs, a British officer stationed in India, had discovered this, had proved it, and had called the attention of the world to the fact. For a half century mathematical gentlemen, such as Bashford, had laid down the law that the point of a bullet made no difference in the flight of a bullet. It does make little difference in the ultimate range, but this is not considered in designing a fighting rifle.

The Germans found that so much did a sharpened point cut down the terrific resistance of the air, that they could shave down their army bullet from 215 grains to 154 grains and still overcome air resistance, and retain the same proportion of the original speed imparted by the rifle as with the old heavy bullet.

This meant, in turn, that they would greatly increase the velocity—the speed—of the bullet, which, in turn, meant that the flight of the bullet would be much flatter, and *ergo*, over fighting ranges, the chances of hitting men anywhere along the field were much increased. Errors in judging range were much less costly, because the bullet did not rise high enough to miss, anyhow. Setting sights or changing sights for changes in range were obviated, because so flat flew the new bullet that for 500 yards or more a man kneeling would be hit anywhere from the muzzle to the 500-yard mark were the rifle sighted for 500 yards.

In other words, the new cartridge—the "S" bullet, it is called by the Germans—gave a danger space of more than 500 yards—500 yards of space from the muzzle of the rifle over which the bullet nowhere got up high enough to go over a kneeling man. This is the result of a flat trajectory or bullet flight, and this in turn comes from a high muzzle velocity, and this in turn can be had only from a light bullet. And light bullets are of no use if they fall off quickly from air resistance, and only the sharp point confers comparative immunity from this terrific resistance through which the bullet has to force its way.

Such is the reason for the sharp point bullet used by the Germans, the French, the Austrians, the British, the Canadians, and probably the Russians to some extent. The Germans termed it a "*Spitzgeschoss*," merely a pointed bullet. It is sometimes termed a "spitz" bullet, with a queer hybrid of German and English in the term, and English-speaking people usually term it a "spitzer," a sort of slangy corruption of the original word. But it is not a "spit ball," our San Francisco friends to the contrary notwithstanding.

The bullet is pointed, not unlike a neatly sharpened lead pencil. It looks quite merciful, so much so that up rose multitudinous fools about the country with the announcement that this bullet was adopted because of its humane disposition.

The United States promptly took it up, calling in its new rifles, the new Springfield, and rechambering the barrels to fire the new ball. The change in this rifle threw out the old blunt nose bullet of 220 grains and with a muzzle speed of 2,200 foot-seconds and substituted a spitzer of 150 grains with a velocity of 2,700 foot-seconds.

The extreme range of the two sorts of bullets is 5,200 yards for the present spitzer, 4,200 yards for the old blunt nose bullet used in the Springfield.

But let me pause here and spear a fallacy common among the uninformed. The extreme range of a rifle—the distance to which it will carry when pointed at an angle of 45 degrees from the horizontal—has absolutely no bearing on its virtues. It is a by-product, not a virtue, not sought for by rifle designers, not cared for by military men, and absolutely not considered. The ballistician in military walks of life cares not a whoop whether the bullet finally winds up 4,200 yards or 4,200 rods from the muzzle if the rifle is fired at an angle of 45. A rifle is no more to be judged by its extreme range than a horse is to be judged by the number of hairs in his eyebrow. Extreme range, we have said, is a

by-product; nobody cares what it is, because it is not used, nor is half of it ever used.

Promise a fighting man a rifle that had a danger space of 1,000 yards but the bullet of which faded into thin air at 1,500, and he'd fall on your neck and call you brother, and probably try to pick your pockets of the plans of the new weapon. Fifteen hundred yards is extreme range for the military rifle in actual use, but very uncommon. A thousand yards sometimes sees the ball open, but often the fighting hardly begins at this distance.

The thing for which all ballisticians strive is a rifle that shoots very flat over fighting ranges which lie under 1,000 yards, to obviate sight changes, and to minimize the cost of errors in range judgment. After that the range of the bullet can go hang; infantry fire is not even remotely effective—worth the ammunition—at ranges half as far as the rifle would carry. Therefore, the surest way to prove that you don't know the first principles of the military rifle is to begin to talk about its range. The two favorite questions of the proletariat—"How many does she hold? How far will she shoot?" The man that knows what is needed asks, "How fast can the magazine be recharged? How flat does she shoot?"

Now, the harmless little sharp point bullet, that promised to ooze through parties on the other side of the argument so gently that they would hardly mind it, turned out to be a little devil. Its evil disposition varies with the rifles in which it is used, due probably to difference of balance of bullet, etc.

In the American Springfield it does just the opposite to what it promises. Because the weight is far back, because of its high speed, and because it is very easily upset, it proceeds to spin widely on its tail when it hits tissue, if not to travel sideways like a hog to battle.

It rips and slashes and knocks things out of time by the shock it imparts. Once in a long while it behaves like a civilized bullet, but not often. It is very freakish in its travel. Stewart Edward White records one bullet that struck a beast in the right shoulder, went through to the left, broke it, traveled down the left leg, came out on the side toward Mr. White, and hit the ground half way between him and the animal!

So the poor soldier may be shot in the watch pocket and have the bullet emerge under his left toe.

Roosevelt was the first writer to call attention to the peevish disposition of this bullet. He took to Africa a lot of regular army spitzer bullets and some 220-grain soft point—dum-dum—jacket bullets. In two weeks he abandoned the dum-dum bullets as being much less deadly than the regular spitzers used in the army rifles of the United States. Mr. White shot 185 head of African game on his first trip with the Springfield and a 165-grain spitzer bullet. He bagged 179 of the 185 hit, showing that the bullet wasted very little time in argument. Understand me, these are full-jacket, sharp-point bullets, with the points untouched, and in no way designed to break up or mushroom. They do neither.

Jack London writes about the ripping, tearing wounds found on the Mexicans at Vera Cruz—all done by the little sharp point bullet in its staggering, tumbling, spinning course through the flesh. On the other hand, the old types of bullets, like those used in the Krag, and in the British 0.303 up to recently, long heavy, metal-patched bullets of blunt point, make clean little holes, and give no such slashing effects.

So, knowing that the Germans, and the French, and the British, and the Canadians—and possibly the Belgians to some extent—all use the spitzer bullet, you can see that the Germans, not reading English shooting literature, might suspect from the effects on their men that the foe were shooting little buzz-saws, not bullets.

Europeans have known for some time of the effect of these sharp point bullets; the Germans should, too. Queerly enough, the German spitzer bullet does not seem to give this slashing, ripping effect; the British report the same effects as those from the older type of blunt nose bullet, clean-cut holes.

Years ago the Russian Red Cross Society asked the Russian Minister of War to inquire into the effects of the pointed bullets, then used for the first time by the Germans and Austrians. The Red Cross people alleged that these bullets had been proved to be unstable, to tip on entering the body, and to keyhole—travel sideways. So the evil effect of the spitzer was a matter of public knowledge years ago, and it seems that the German bullet was not immune.

So, except for the looks of the thing, if the British choose to use their old Mark IV, hollow point, Zulu-killing bullet instead of their Mark VII spitzer, they will be doing the foe a kindness—by departing from the rules of the convention.

Shooting for experiment on the tough Catalina wild goat, I have killed, with a companion, five goats with five shots from the army Springfield. Every one died instantly, yet not one was like any other in the effects. One was slashed open alongside as if hit with a giant knife, and his entire internal economy exposed. Another showed no mark either of exit or entrance, another had a slash along the back where the bullet hit, as if he had been struck with a cleaver, but the bullet had not gone in more than enough to break the spine; while still another had a terrific slashing wound of exit in the shoulder.

The Nutritious Sugar-beet

THE sugar-beet, due to highly efficient breeding, yields under existing farm conditions the largest amount of digestible dry substance per acre of any crop grown. Northern Colorado, during the last decade, has produced an average yearly crop of about 12 tons of sugar beets per acre, containing 22½ per cent digestible dry substance and about 9.6 tons of tops per acre, containing 15 per cent digestible dry substance, or a total of 8,200 pounds of digestible dry substance per acre, if all of it could be utilized as a stock food. The immensity of this figure will be more apparent when it is realized that it would take a crop of 100 bushels of corn and 4½ tons of fodder per acre, or a crop of 8.2 tons of alfalfa per acre, to equal the quantity of digestible food produced by the sugar-beet. Although such crops of corn and alfalfa are possible, they are rarely, if ever, produced, while the sugar-beet crop mentioned has been grown on an average for ten years in the vicinity of Fort Collins, Col. In fact, during these years a large proportion of the growers have exceeded this average, while in favorable crop years the entire average has been considerably higher.

Of course, the cost of growing an acre of sugar beets is considerably higher than the cost of growing a like area of corn or alfalfa; but this is offset by the fact that, by means of the sugar factory, it is possible to extract from the beet a portion of the digestible dry substance in the form of sugar, to the extent of from two to three thousand pounds per acre. The price obtained for the sugar covers the expenses and profits of farm and factory, so that the remaining food properties may be sold at prices below the level of equivalent available foods.

At present all of the available food value of the sugar-beet is not realized. This is due partly to the indifference of the farmer, partly to the fact that feeding on a small scale on the farm is not popular, and partly due to the recent establishment of the industry and the uncertainty that heretofore has discouraged the factories from investing permanently the large sums necessary to obtain all of the food content possible in the most economical form.

A Substitute for Glass in Automobiles

FOR many years it has been one of the endeavors of automobile body manufacturers, especially of limousine and sedan bodies, to find a substitute for the dangerous glass, used as windows in these motorcars. Several types of "safety glass" have been proposed, but for some reason or other it has been found impossible to eliminate the splintering glass with its danger of cutting the passengers in a collision. In tops for touring cars, on the other hand, celluloid and mica have also been found very unsatisfactory, and their continued use has been continued for the simple reason that nothing better so far has been discovered.

Now, however, a material has been brought out by one of the largest manufacturers of explosives in the world, under the trade-name *Cellon*, which possesses some remarkable qualities. In the first place, it is almost unbreakable by ordinary handling. Sheets of this material can be bent backward and forward many times, without breaking; blocks of this transparent product can be subjected to blows without showing fractures; it can be produced in any desired thickness, up to half an inch, in plates measuring 140 by 60 centimeters. In rods and tubes the material can be had in any desired thickness. Clear and completely transparent, light or dark colored, mottled or even black, it can be used for the manufacture of all objects now made of celluloid.

Its chief advantage over celluloid is its safety against fire. A sheet of cellon may be ignited by an open flame, but the burning portion will melt and a few drops of the material will fall to the ground. It will not continue to burn. Its weight can be calculated for any desired thickness and size from the statement that a plate 60 by 140 centimeters, 1 millimeter thick, will weigh 1 kilogramme. Translated into inches and pounds, the material weighs about 2.6 ounces per hundred square inches of 0.04 inch thickness.

Cellon is fastened by nailing it down, thin sheets by sewing on; it can be glued on by the use of "cellon-lack." It is used for telephones, electric switch boards, toilet articles, windows for automobiles and aeroplanes and dirigibles (see Zeppelin passenger ships), and is a perfect isolating material for all electric apparatus; can be cut and trimmed with an ordinary knife; warmed in hot water and then molded in any desired shape; is impervious to water, gasoline, petroleum, oil, turpentine, and gas.

Cellon-lack, the new varnish made with cellon as a base, promises to become invaluable as a varnish for aeroplane and balloon materials, because of its resistance to the influences of gasoline, oil, and water. Instead of reducing the tensile strength of these materials, cellon-lack is said to increase it.

While at present there seems little chance of this material being introduced in the United States, the end of the present war will undoubtedly see its use in American industries. The process of manufacture is patented by Dr. Eichengruen, in Germany.

The Work of the "Scotia" in 1913

THE British government has just published in two volumes, one of text and one of diagrams and charts, the detailed scientific results attained in connection with the ice patrol of the "Scotia" in 1913. It will be recalled that after the loss of the "Titanic" in April, 1912, attention was called to the question whether any steps could be taken to render Atlantic steamship routes more safe by establishing an ice patrol to the north of these routes, and in the following spring the "Scotia" was sent out experimentally for this purpose at the joint expense of the British government and the shipowners. The scientific staff included a hydrographer, a meteorologist, and a biologist. The expedition sent daily wireless reports on the state of the ice and the weather to the nearest land station, whence they were ultimately distributed to vessels and to the hydrographic and meteorological offices of the United States, Canada, and Great Britain. The scientific work included a wide range of hydrographic, meteorological, and biological investigations. Fog, which is no less important than ice in the area under investigation, was the subject of numerous observations, in which good use was made of meteorological kites. The whole undertaking was so successful that the International Conference on Safety of Life at Sea, which met in London in November, 1913, established an international ice patrol to continue on a larger scale the work initiated by the "Scotia."

The Current Supplement

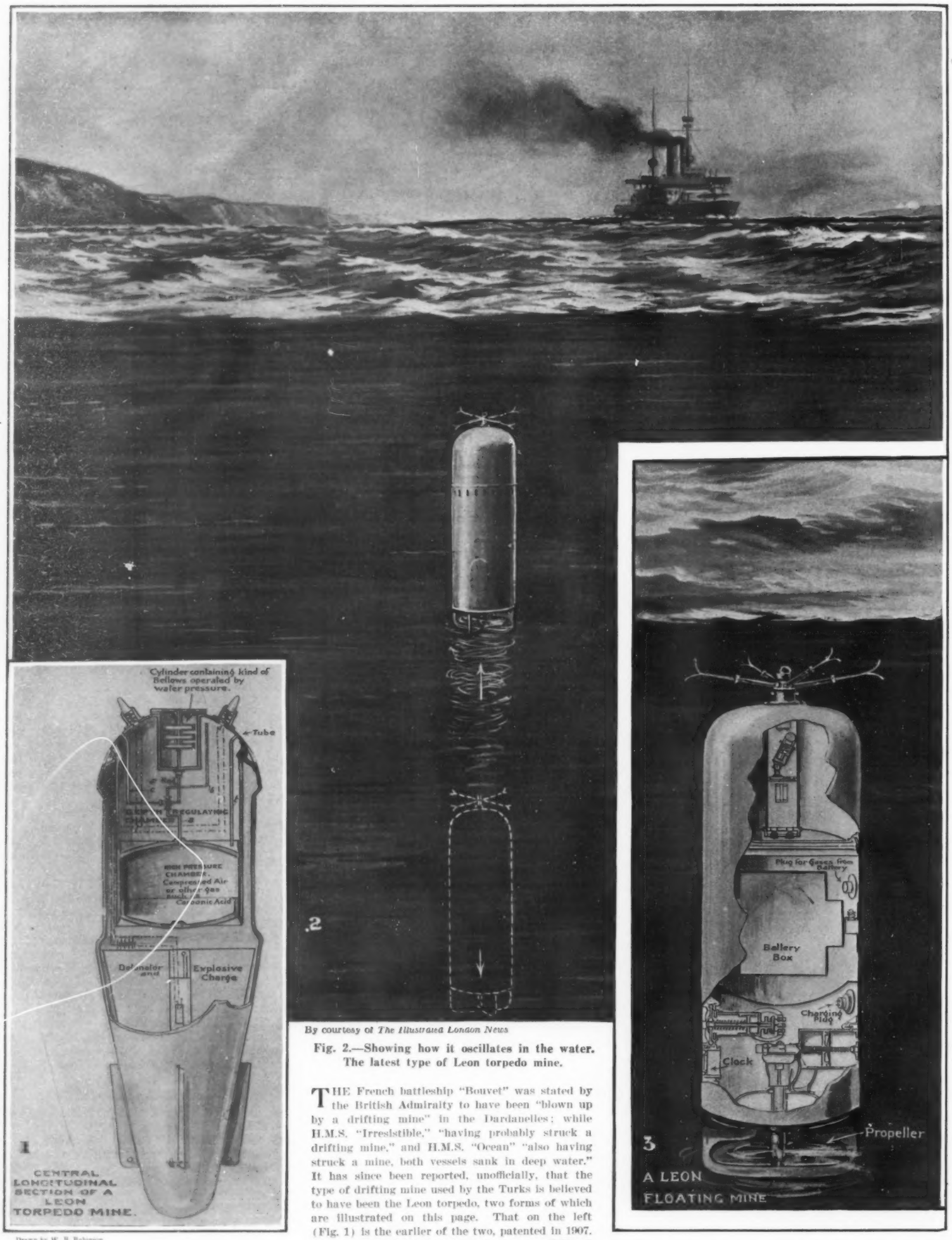
MANY branches of modern science depend for their interpretation and explanation on the "ion," and a thorough understanding of ions and atoms, and their relationship, is indispensable to the modern scientist and necessary for the understanding of scientific literature. Many will find the lectures on this subject by Sir J. J. Thomson, the first of which appears in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2052, for May 1st, 1915, absolutely invaluable. An article on vocational guidance is a particularly timely topic of modern welfare. There is an illustrated description of the operating mechanism of the U. S. collier "Jupiter," telling how warships are coaled at sea. How the rifling of the barrel of a firearm affects the flight of a bullet is explained in a most interesting article, with several diagrams. There is a discussion of the dyestuff situation. Notwithstanding all that has been written about the conduct of the great war few appreciate how widely the automobile truck has been utilized and the great variety of different tasks which it is successfully performing. Something of this is told in the article on The Motor Truck in Modern Military Service. Another matter of interest is the description of the manufacture of gasoline by "cracking" crude oils. Much has been printed about the German "Taube" aeroplanes. An account of the evolution of this type, with a number of diagrams is given. An important subject is the formation of ozone in the upper atmosphere, and the article begun in this issue treats of experiments and observations made for determining this question. There are also articles on gaseous explosions; a steam-electric wrecking crane; the evolution of the elements, and a consideration of the work of Prof. Arthur von Auwers, the astronomer.

Hand Firing of Soft Coal

IT is not often that a Government bulletin attracts more attention or promises more real benefit in its sphere than the Bureau of Mines publication on Hand Firing Soft Coal Under Power-Plant Boilers. It chronicles the results of actual tests and seeks to so present the subject as to meet the need of men without technical education. So far as possible it avoids technical language, and it is so worded and illustrated that it will aid the work of practical firemen and should be the handbook of all engineers and firemen capable of following printed instructions.

To Old Readers of the Scientific American

THE June number of the SCIENTIFIC AMERICAN will commemorate the seventieth anniversary of the house of Munn & Co. In that number we wish to give a history of the SCIENTIFIC AMERICAN. Old readers and subscribers who visited the editorial offices in the past are requested to send us their impressions, anecdotes, experiences, and the like. Indeed, any information at all relating to the old offices on Park Row will be gratefully received by the Editors.



Drawn by W. B. Robinson

Fig. 1.—A Leon torpedo mine shown in section. The earlier form.

By courtesy of *The Illustrated London News*

Fig. 2.—Showing how it oscillates in the water. The latest type of Leon torpedo mine.

Fig. 3.—The latest type of Leon torpedo mine. A sectional diagram.

THE French battleship "Bouvet" was stated by the British Admiralty to have been "blown up by a drifting mine" in the Dardanelles; while H.M.S. "Irresistible," "having probably struck a drifting mine," and H.M.S. "Ocean" "also having struck a mine, both vessels sank in deep water." It has since been reported, unofficially, that the type of drifting mine used by the Turks is believed to have been the Leon torpedo, two forms of which are illustrated on this page. That on the left (Fig. 1) is the earlier of the two, patented in 1907. Fig. 3 represents its latest development, and Fig. 2 shows how it oscillates vertically in the water. This mine was invented by Capt. Karl Oskar Leon of Karlskrona, Sweden. A torpedo mine is so called because it can be ejected from a tube like a torpedo. It does not, however, move horizontally like a torpedo by its own power, but it can be set to oscillate more or less vertically beneath the surface at any desired depth. In the type shown in Fig. 1, the oscillating mechanism is regulated by means of compressed air in a chamber within the mine. The bellows are extended by increase of water pressure and contracted by its decrease. Water is admitted to the depth regulating chamber and expelled from it through the tube *t*, which communicates with the water surrounding the mine. The explosion of the mine is caused by impact with the two spring-pressed horns seen projecting at the top in Fig. 1. The mine shown in Fig. 3 floats almost vertically in the water. It sinks to a certain prearranged depth at which the propeller is automatically actuated to drive it up again. The action of the propeller can be made to begin and cease at any depth desired. The time during which the mine is to float can also be regulated.—[*Drawings Copyrighted in the United States and Canada.*]

SINKER OF THE "BOUVET," "IRRESISTIBLE," AND "OCEAN"?

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Military Preparedness

To the Editor of the SCIENTIFIC AMERICAN:

I have been much interested in your articles on our military preparedness. I was a member of the cadet organizations at Pennsylvania State College, where I graduated a few years ago, and where I ranked as captain. I feel that your comments upon our training are true, that the training of such camps (summer training camps for officers) as you describe would be very good. W. J. DUMM.

Newark, N. J.

Military Drill in Place of Gymnasium

To the Editor of the SCIENTIFIC AMERICAN:

I have read with much interest the articles on "An Undefended Treasure Land" and am heartily in sympathy with them, as I believe are the majority of our people. I have wondered if the idea had ever been suggested, that the various State universities substitute a military drill for the gymnasium, or at least make it optional, and allowing the same credits as for gymnasium work. It seems to me that this would be of great benefit to the student and at the same time give us a large body of well-drilled men.

Boulder, Col. ERNEST GRILL.

Military Drill in the Public Schools

To the Editor of the SCIENTIFIC AMERICAN:

Now that the "fad" is to talk about "whether our standing army is sufficient or insufficient in case of war," I wish to suggest the following:

Instead of increasing our standing army so that we may have a stronger military protection in case of war, why not have military drill-masters at our public schools and thus have every boy, say from ten years up, trained to military tactics? Not only would it be of benefit to the youths from an athletic standpoint, but it will also create a *drilled reserve* of those who, as a rule, volunteer their services in case of war.

The cost to the Government of keeping drill-masters at the public schools would be comparatively with other means, very small. In order to create enthusiasm and interest among the youngsters, the forming of companies, regiments, etc., and promotion in rank should be given to those who deserve the same. This will keep the young ones interested in their military training as well as the rest of their school studies.

However, this is merely a suggestion, and if you consider it practical and sane, I will appreciate your comment on same. MARTIN I. ZOFNESS.

A Letter from an Old Reader

To the Editor of the SCIENTIFIC AMERICAN:

It may be of interest to you in connection with your anniversary number, which I notice is soon to appear, to realize how important the SCIENTIFIC AMERICAN was regarded by practical men in its earliest years. Along about 1851 or 1852, when I was an apprentice in the machine business at Baltimore, my preceptor, a man named Shipley, showed me a copy of the SCIENTIFIC AMERICAN and told me that I should subscribe to it, as it would be of assistance to me in my studies relating to the business which I expected was to be my life's work. I followed his advice and subscribed to the SCIENTIFIC AMERICAN and continued to read it for years with great advantage, and I take pleasure at this time of life in writing you to such effect.

Washington, D. C. R. C. GILL.

The Drug Habit

To the Editor of the SCIENTIFIC AMERICAN:

A recent note credited by you to a publication of the United States Public Health Service, and concerning the use of narcotic drugs, is likely to give a wrong impression regarding the prevalence of this condition, because the publication of the Public Health Service is based on data which have since been greatly extended.

Under the permit system therein alluded to, our data up to March 1st, show about 2,500 addicts of the opiates. We estimate that this is about one half of the number in the State and possibly even a smaller proportion. Since this State has about 2½ per cent of the whole population of the United States, if we assume that Tennessee has only the same proportion of addicts as of population we have about 225,000 addicts in the whole country. But Tennessee being an agricultural State, and, therefore, decidedly more free from such addictions than those States where the pressure of modern life is harder, we should add 10 per cent at least to this number, giving us in round numbers 247,000 addicts of the opiates alone. It is safe to say that there are 250,000 addicts of the opiates in the United States, and that they annually use about $6,500,000 worth of the drugs unnecessarily.

This is very different from the 2,000,000 at which the figures have been set by somewhat sensational writers, but it is bad enough, as the addict of the opiates is ordinarily to be classed as a defective. The Harrison Act restricting traffic in these drugs was not passed a moment too soon, and appears to have accomplished an enormous amount of good, for, under our form of government, only national legislation on this subject will absolutely prevent illicit traffic in these drugs within the States.

The Food and Drugs Department of Tennessee is the enforcing agent of this law and the figures given above are taken directly from our books.

Nashville, Tenn. LUCIUS P. BROWN,
Food and Drugs Commissioner,
State of Tennessee.

Construction of Selenium Cells

To the Editor of the SCIENTIFIC AMERICAN:

I note your article on "Constructing Selenium Cells" in the SCIENTIFIC AMERICAN of February 27th, 1915. Having constructed selenium cells for the past eight years, I think a few remarks from the pen of a man with this experience will be of interest to your readers.

In the above-named article you say that selenium cell constructors "will not employ any other metal than platinum." Permit me to correct this statement. Copper and nickel are used extensively on account of their being cheaper. The object of using platinum is that selenium forms selenides readily with all metals excepting platinum. It is these selenides that make the cell insensitive and useless. I have made several hundred cells, using copper, and I have never had any trouble with them; they are all in practical use to this very day.

Experimenters desiring to make selenium cells should not make use of a slate base, as the metallic veins short-circuit the cells. The best material I find for a base is either soapstone, mica, or porcelain.

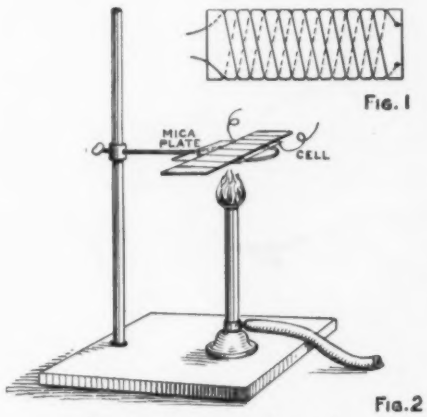


FIG. 1

FIG. 2

Construction of selenium cells.

As explained by the writer in a recent issue of *Electrical Experimenter*, a selenium cell of the "Bidwell" type can be made by taking a slab of the above-named material, bifilar shape, 2¼ inches long and ¾ inch broad, and beginning at ¼ inch from one end, wind round it in the form of a flat spiral some No. 40 copper or nickel wire. The pitch of each turn of the spiral is $\frac{1}{64}$ inch from its neighbor. Continue winding up to ¼ inch from the outer extremity, then fix the two ends of the wire, by passing them through holes drilled in the slab. Now take a second wire and carefully wind this on beside the other, thus forming a second spiral, the turns of which are midway between those of the original one. Fix this as before (Fig. 1). Great care must be exercised that the two wires do not touch each other at any point. It will be well to make sure by testing this with a telephone receiver.

For the succeeding operation a retort stand at least 15 inches high is convenient. Fix the ring 15 inches above the base; on the pedestal place a Bunsen burner. On this ring (Fig. 2) lay a flat sheet of brass $\frac{1}{16}$ inch thick, and on the brass a piece of mica (to save waste selenium). Place the embryo cell on the mica plate, having brought the Bunsen burner close under the brass, melt a few grains of stick selenium in a small spoon and let four or five drops fall upon different parts of the cell. Spread the melted selenium evenly over the surface with a piece of mica, a steel knife or spatula, and at the same time pressing it well between the wires.

During this process the temperature must be carefully regulated by raising or lowering the temperature of the Bunsen burner. If the temperature is not high enough the selenium will begin to crystallize; if too high, the selenium will collect in drops, being apparently repelled from the surface of the cell. The temperature should, in fact, be just above the fusing point of crystalline selenium. When a smooth surface is obtained, quickly remove the cell with pliers and let it cool. Its surface will now be smooth and lustrous.

The cell must next be annealed. The brass plate being cool, lay the cell upon it again, and adjust the burner at its lowest possible point. The selenium will soon begin to crystallize, as evidenced by its surface assuming a dull leaden appearance. (If crystallization has not begun in five minutes, raise the burner an inch or two.) In from five to ten minutes the whole of the selenium should be crystallized. Then gradually raise the burner until signs of fusion just begin to appear. This will probably take place when the flame is within three inches of the brass. Instantly remove the burner, and in about ten seconds re-crystallization will occur. Now fix the burner ½ inch below the point at which it was when fusion commenced, and let it remain for four hours, merely looking at it from time to time to ascertain that, owing to increase of gas pressure or other causes, the heat has not become too great. After four hours, begin cooling by lowering the burner an inch or two, and repeat this operation every ten or fifteen minutes, until the burner is at its lowest point. Then slightly lower the gas flame at short intervals, until it is finally extinguished. When the brass plate is quite cool, the cell may be removed.

A cell made in this manner is found to have a resistance in the dark of from 50,000 to 100,000 ohms.

New York city. SAMUEL WEIN.

A "West Point" for Non-commissioned Officers

To the Editor of the SCIENTIFIC AMERICAN:

All but a few extreme pacificists will admit that the United States is not properly prepared in a military way for even the smallest war emergency. All but a few extreme militarists will admit that the United States does not need an enormous standing army. Between these two extremes, is not the following plan sensible, logical, and practical?

Should war be declared, the graduates of West Point will provide material for officers of the very highest type and training. The young men of America between 18 and 40 will provide material for the common soldier second to none in the world. The great lack will be in the non-commissioned officer.

I think it will be admitted that an army of recruits can be whipped into form by a West Point officer in a very short space of time when he is properly supported by non-commissioned officers. Upon the supply of non-commissioned officers will therefore depend the quality of the American army and the length of time necessary to form it.

I wish to suggest the organization of a second "West Point" for the training of non-commissioned officers. Men should be admitted to this academy upon the same competitive basis that is required for admission to West Point. They should be trained to become properly complementary to the regular commissioned officers. They should be educated to take charge of the humbler tasks of war—the digging of trenches, the throwing-up of fortifications, bridging rivers, etc. They should be trained to drive engines and automobiles, to guide aeroplanes, to erect wireless stations. They should be made adept, as a matter of course, in military drill. In short, they should be educated scientifically to fill that humble but vastly important place in army management which heretofore we have left to chance and costly experience.

But—and here is the real merit of the proposed plan—they should be so educated that the knowledge they acquire in the arts of war may be equally valuable to them in the arts of peace. Instead of training them solely for a war that may not come in their generation, their training should be such that they will leave the institution equipped to take a skilled man's part in the industries of the country.

In payment for this education, they are to be subject to the call of their Government. They might even be required to spend a short term of years in the regular army. But, depend upon it, if our Government will equip men with such a training no reasonable requirements of service will prevent thousands of young men from competing for the opportunity to enter such a school.

With trained and experienced officers and non-commissioned subordinates, an American army could be mobilized and trained in an incredibly short space of time. Then let the Government work more closely with our national guard, compensating the young men who are giving their time and energy to this thankless work. Let a system of medals be provided for excellence in sharpshooting by civilians and for military drills by citizen-bodies.

The result of this would surely be the creation of a great army of peace which could at short notice be transformed into a vast army of war that would creditably represent and defend the peace and dignity of the United States. F. C. BUTLER,

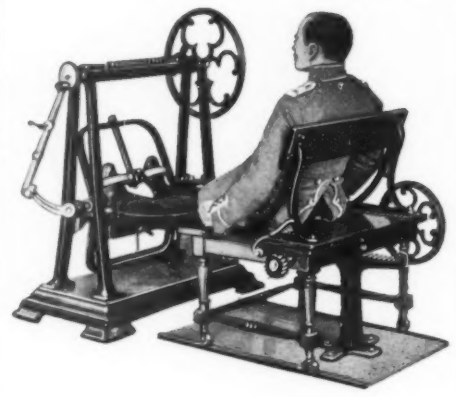
Secretary, Chamber of Commerce of Kalamazoo.
Kalamazoo, Mich.

Pedal which bends and stretches the foot.

The Mechanics of Convalescence

Methods of Hastening the Cure of German Wounded Soldiers

By Walter Bannard



Exercising the legs.

MEDICINE and surgery have had a very serious task set before them in the handling of the vast hosts of wounded men in all the belligerent armies. It is to the credit of the members of the healing profession that, both as individuals and organized bodies they are coping courageously and wisely with the great undertaking so suddenly thrust upon them. So far as known, they have never failed to give their Samaritan care impartially to friend and foe. Someone has said that the curative art is the only present-day branch of science which is benign to all men alike. There is sore need of some benign influence in the terrible struggle, for the injured men already under care may be far exceeded in numbers by those wounded in the coming days of the war.

Outside of inoculation for tetanus it is stated that no strikingly new treatment has so far appeared in the care of wounds and disease, unless the vaccine for typhus just announced should prove its utility. The work done has been largely the application of the advances of medical and surgical science in the cure of the ordinary ailments and accidents to which mankind is liable. These advances, though, have of late years been very great. There is above all the advance, most important in surgery, in the prevention of blood poisoning, there are the increased knowledge of sanitation, the use of the Röntgen rays, and the benefits arising from other recent discoveries in the art of healing. Owing to all these improvements, we are told, large numbers of the wounded are rapidly cured and returned to the front.

It is not at all strange that the medical and surgical skill of times of peace should be so successful in the era of war. Rheumatism, pneumonia, and typhus are much dreaded diseases of camp and trench life, and the treatment of **fractured bones** or other bone injuries by shot resembles that of accidents to the bones in ordinary life. The main object in the surgery both of war and peace is to restore as completely as possible the natural functions of the injured parts, so that the improvements in the treatment of accidents made of late years can now be happily used to shorten the soldier's convalescence. Heat, light, and electricity, which have all their successful applications in medical and surgical science, have been turned to good account, and mechanico-therapy has proved of much value, especially in the after-treatment of injuries which leave stiffened joints.

The methods of mechanico-therapy are not largely used in the United States. This system of treatment had its origin in Sweden and its theories have been largely developed in that country and also in Germany, where the use of machinery in the cure of injuries to the bones, nerves, and muscles is widely extended both in hospital and private practice. Dr. Charles H. Jaeger, the well-known authority on mechanico-therapy, states that, in reply to his inquiry, some six hundred institutions and physicians in Germany said they used medico-gymnastics to hasten convalescence not only in affections of the joints, but also, in many instances, in diseases, as pneumonia and pleurisy, and after operations not referring particularly to joints. Most of them had been using this treatment for a considerable period of years, and convalescence, in the general opinion, was decidedly shortened thereby. One reason for the large use of mechanical methods in the treatment of injuries in Germany is the compulsory state insurance of workmen, which obliges the employer to bear the greater part of the expense of illness from accidents. This naturally leads the master to seek after methods for shortening the duration of the workman's inaction, and Germans declare that mechanico-therapy has proved a good way of detecting the lazy worker who wants to live off the insurance fund. This form of treatment being of such general use in Germany, it is not surprising that the military hospitals there are largely equipped for it, as the illustrations show, a provision which now stands them in good stead.

The mechanical treatment is generally an after-treatment, although it may begin before the injured bone or joint is entirely healed. It is based on the idea that lack of use leads to lack of nutrition and atrophy of the part, and its aims are the improvement of nutrition and the maintenance of functions. It seeks to attain these ends by massage and gymnastics. Various kinds of machinery are used which have different methods of maintaining movement, but the force of all is adjustable and the movement is defined. The movements are active, the patient taking part, passive, in which the patient is acted upon without his own exertion and resistant, in which the machine exerts a regulated resistance to the action of the patient. In these exercises the patient stands, sits, or lies, according to the treatment required, as may be seen from the illustrations. Among the apparatus used is machinery for bending, stretching, or rotating various joints which may be stiffened from trench-rheumatism or from a wound; machinery for expansion of the lungs, thus permitting better oxidation of the blood after a shot in the breast; machinery for producing mechanically such operations as percussion, friction, kneading, or vibration. These last operations are also performed by hand massage. Hand massage is one of the cures of antiquity revived and scientifically developed in the latter part of the last century. The soldier of to-day has the benefit from it once enjoyed by the Roman legionary.

Other aids employed to hasten the cure of soldiers eager to be back at the front are electric light baths, currents of hot air heated and kept in motion by electricity, and electricity in various other forms, as direct and low-frequency currents, which aid in overcoming the paralysis of muscles or nerves caused by a wound. All men who are hurt in a war are not necessarily wounded. In a strenuous life calling for violent exertion many ordinary accidents may befall them, or they may be stunned or otherwise injured by the wind-concussion of the huge shells.

To-day plastic surgery allows the preparation of stumps which can support artificial additions much better than was formerly the case. Maimed soldiers, the melancholy aftermath of war, are not now condemned in as great measure as in past times to inaction and methods of earning a living that are only modified forms of beggary. The belligerent countries are already trying in various ways to meet the problem of equipping the cripples of war for their new conditions of life. In England convalescent crippled soldiers are being placed in homes for crippled children, where they can learn suitable ways of earning a living. The care of maimed soldiers in Germany was assigned last August, only a few days after hostilities were declared, to the German Society for the Care of Cripples, which immediately began to make plans for work on a large scale in connection with the authorities and private benevolent organizations. This journal gave some account not long ago of a book written by a one-armed German, who wished to show German soldiers similarly maimed how to wait on themselves. The same desire to help those of like affliction has led an English officer, blinded in the Boer war, to undertake the teaching of the independence he has gained to men who have lost their sight in the present struggle.

Although science and devotion to the task have wrought so many successful cures in this war, there are injuries which still baffle them. A doctor in an American hospital for the wounded is reported to have

Apparatus for breathing gymnastics and passive expansion of the chest.

A number of electric hot-air apparatus employed for treating stiff joints.

Apparatus for use in limbering up arms and fingers.

said that the staff had had next to no abdominal cases. This would indicate that such patients are apt to die before reaching the base hospital.

The Government's Competition for a Naval Dirigible

By C. Dienstbach

THE British War Office transferred, some time ago, all its army dirigibles to the navy. In soliciting bids for naval dirigibles the American Government seems to have been guided in its policy toward the long neglected lighter-than-air machine by the identical considerations which influence the British—that only dirigibles may be depended upon for long-range over-sea work. This theory is brilliantly vindicated by the German naval Zeppelins. According to a recent authentic statement, they cruise about over the North Sea as if it were a mill pond and simply shoot down interfering hostile seaplanes. This must be borne in mind to appreciate the published conditions of the American dirigible contest.

Appropriations by Congress are scanty, even for inexpensive aeroplanes, of undoubted utility, and with the memory of the sensational failure of the large British naval airship "Mayfly" still sufficiently fresh, it is not surprising that these conditions ask for a "sample" airship of pigmy dimensions, as dirigibles go. But it is rather misleading, when the Government calls this a Vedette type. This French term means essentially a small army dirigible, a "disguised aeroplane" of short range, almost as easy to provision, transport, store, and operate, but also of marked simplicity. Any reduction of the "aerial dreadnought's" resourcefulness finds there no more room than in the average aeroplane. Renard, the ingenious designer of the first true dirigible, "La France" of 1884, excused his failure to follow up his success with these words: "What are two hours! A dirigible which cannot plough through the air for twenty hours is useless." Renard's opinion is revived in reading conditions which ask for only two hours' running at full speed.

In the true Vedette type every other advantage is, for good reasons, sacrificed to vital radius of action and speed, both so difficult to attain with a small dirigible.

Far from being a Vedette, the airship aimed at by the Government's conditions tends to become a "miniature Zeppelin," not the least by religiously obeying the much-debated "full crew law." From the four-men crew of a Parseval Vedette of 128 feet length, 25 feet beam; a Zodiac Vedette of 134 feet length, 28 feet beam; an Astra-Torres Vedette of 156 feet length, 27 feet beam, with displacements ranging from 42,384 to 54,746 cubic feet, to the eight men crew demanded for the first United States naval dirigible of 175 feet length, 35 feet beam (and corresponding displacement with a Parseval hull of 81,155 cubic feet, with a Zodiac hull of 80,727.50 cubic feet, and an Astra-Torres hull of 79,625 cubic feet) is not a short step. But the conditions also call for an inclosed car to serve as a boat. What that imposes the designers of Brucker's transatlantic airship have found out. There must also be swiveling twin propellers, double balloonet control, combined with horizontal rudders, two motors, mooring arrangements, and possibly wireless and lighting equipment, and stabilizers.

Evidently the first United States naval dirigible is to be as complete as a modern automobile. To offset these exacting demands the speed has been reduced to less than four fifths and the radius of action to less than one third of what a true Vedette could speed (and incidentally a wide radius of action) most for any given size should be put at the highest premium. While there seems little doubt that the submitted designs will not be judged merely by their close conformation to the conditions, but by their general excellence, there is less assurance of competitors not being guided too much by the mere conditions. They would be justified if the competition were only for the best training ship. In a training ship the principal merit does consist of providing on a small displacement the accommodations and the equipment of a large craft. But in this way it becomes inherently a poor model to enlarge. In the details of the conditions due consideration has been given to modern experiences. The importance attached to mooring the ship to a mast in a fifteen mile wind, and to its ability to weather a forty-mile gale while thus anchored deserves special credit.

Perfecting accessories furnishes likewise a stepping stone to enlarged units where they are indispensable, only of less importance than insuring speed. Complications are even easier on a small scale owing to the relative strength of materials inversely increasing with size.

realize on a similar displacement. But in this way the first American naval dirigible, except that it will furnish a test of technical skill, materials and workmanship available in the United States (the clause stipulating continuous Government inspection of the materials and the building process seems very wise) will be useful only as a training ship. (The stipulation for a numerous crew seems moreover to make this special purpose clear.) But the conditions will not in themselves guarantee that the winning design may also be a proper stepping stone and model for larger units. They rather seem to invite the reverse. Obviously, for instance, the lightest aeroplane engines will be equal to a run of only two hours, and the temptation is great to dodge in this way—decidedly poor dirigible practice—other difficulties of getting the most out of the allotted weight. It would be a very complicated undertaking to ponder all the advantages and disadvantages of a hundred different compromises to comply with the exacting conditions, but it may be safely stated that they generally tend toward the small, sturdy British "Greek Letter Type," with much lift for its dimensions, and permitting of a good deal of useful equipment, such as, for instance, the swiveling propeller specially demanded in the American competition, but slow and decidedly no model for enlarged units. Speed is the prime requisite in a dirigible, because head resistance increased with the source of the velocity and a true Astra-Torres Vedette of forty miles an hour on 156 by 27 feet has actually proved the best model for enlargements. It is easy to make use of the extra lift gained by increasing the size for supplying any amount of equipment, but to improve inherently slow speed by mere enlargement is a much less efficient proceeding, in any competition. The system which favors

So-called Humane Bullets

WE are told in the current newspapers that Alexander Foster Humphrey of Pittsburgh has invented a bullet supplied with narcotics and antiseptics, the former to relieve the pain of a wound and the latter to aid the healing operations. At least two patents have issued for narcotizing bullets, both especially designed for use in capturing the lower animals. One patent issued in 1910 to James Francis O'Byrne and Thomas A. Flood of Salt Lake City for a bullet carrying a narcotic whose anaesthetic effect when shot into a fleshy portion of an animal would so affect it as to render its capture and control comparatively easy. The other patent was issued in 1911 to K. Burgsmüller of Kreiensen, Germany, for a cartr'dge filled with a mixture of capsicine in an immediately gasifiable form for narcotizing animals.

A Welcome New Scientific Journal

IT is a well-recognized fact that the progress of science is seriously impeded by an overabundance of scientific journals. Almost every scientific man finds that a deplorable amount of his time is given to the task of gathering together from scores of periodicals the *disjecta membra* of the literature in which he is especially interested, and, to make matters worse, there is always a certain residuum of such literature that escapes his vigilance on account of its out-of-the-way place of publication.

Hence, the advent of a new scientific periodical is not hailed with general satisfaction unless there are very special reasons to justify its existence. Such reasons undoubtedly authorize the appearance of the monthly *Proceedings* of the National Academy of Sciences, which began publication last January. In fact, the *Proceedings* at once takes rank among the few journals that are indispensable.

Not long ago we greeted the new *Journal* of the Washington Academy of Sciences, which so admirably epitomizes the progress of science at the capital, as the nearest approach yet realized in America to an analogue of the Paris *Comptes rendus*. This characterization may be even more aptly applied to the new organ of the National Academy. Its aim, as announced, "will be to furnish a comprehensive survey of the more important results of the scientific research of this country." It is not designed to replace or displace any previously existing journal, since its contents will be limited to brief advance notices of important scientific achievements, the more detailed reports of which will appear elsewhere. The maximum length of contributions is fixed at 2,500 words. Authors are, however, cautioned to be precise in making clear the new results and to give some record of the methods and data on which they are based, as well as of the relation which the paper bears to previous publications on the same subject.

The managing editor is Prof. E. B. Wilson of the Massachusetts Institute of Technology.

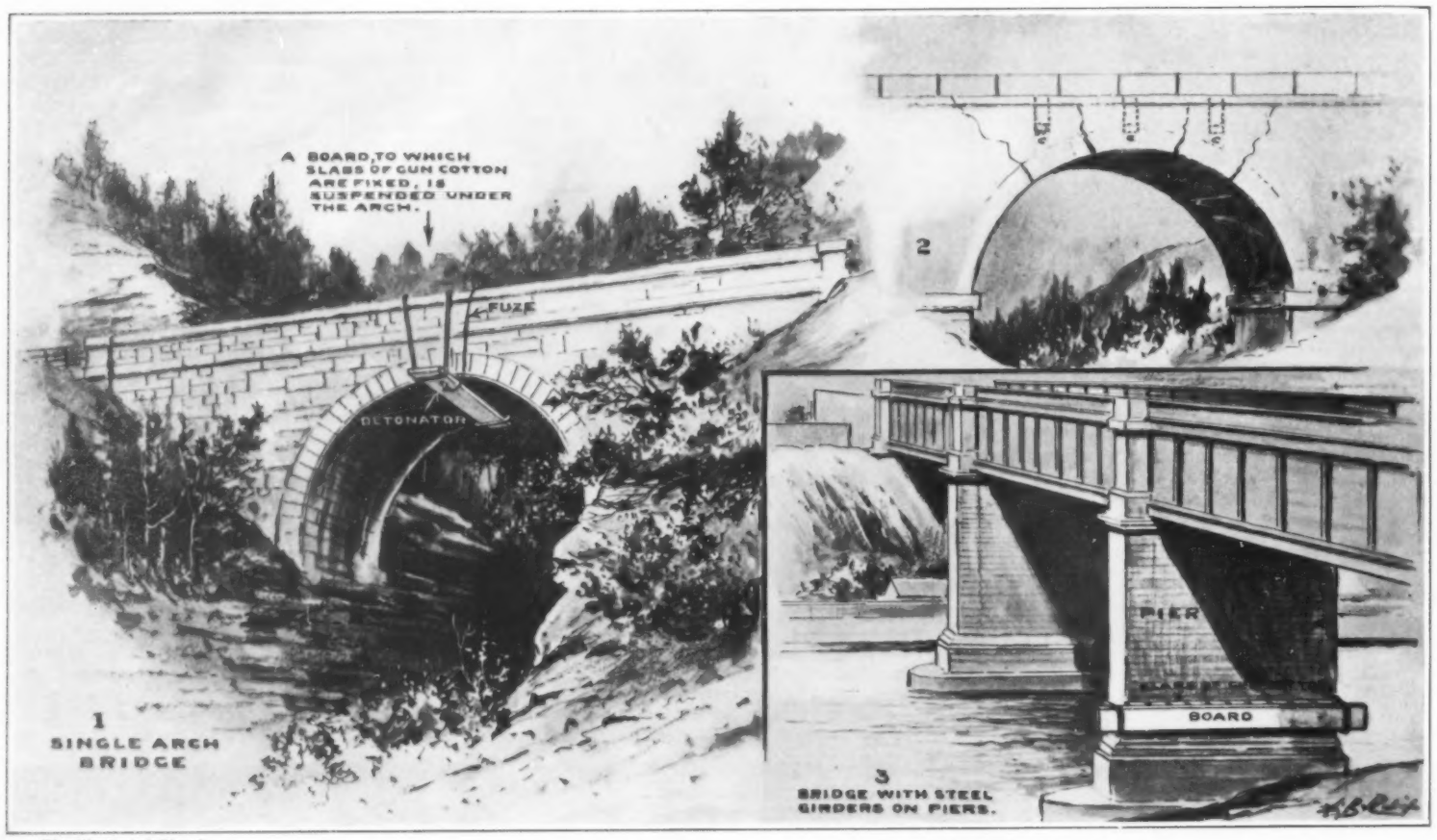
Motor-driven apparatus for massage of foot and back and percussion of arm; to left, convalescent on riding apparatus.

Medico-mechanical treatment of members stiffened by wounds; passive extension of knee and trunk.

The American Hog in New Pastures

IT has remained for American brains and American capital to put to practical and profitable use that greatest of all problems of the hot, low countries of Central and South America—the worn-out banana land. Experiments conducted by American planters have shown that hogs pastured on grass and fattened on bananas produce a superior, almost odorless lard and finely flavored meat. Hogs, it has been found, can be raised on the worn-out banana lands and fattened on the small, unmarketable bunches of fruit borne on these areas. So much for the banana land in the course of its deterioration!

When bananas may no longer be grown, the land will produce bountiful crops of sugar. Two thousand acres, near Ceiba, Honduras, the banana yield of which was long ago exhausted, has so responded to sugar cultivation that a sugar mill has been erected on the premises by the Honduras Sugar and Distilling Company, at a cost of half a million dollars, to take care of the resulting cane crop.



The Illustrated War News.

Bridge destruction methods used by military engineers in the case of arched and girder bridges.

Protecting a Retreating Army

Effective Methods of Destroying Its Lines of Communications

IN times gone by, when armies were of comparatively small size, and battles were largely hand to hand contests, it was frequently possible to subsist the troops upon the supplies of the surrounding country; and as the weapons consisted of single-shot muskets or rifles and cannon of small size, it was not difficult to carry along a supply of ammunition sufficient for a considerable time. Now this is all changed, and continuous and rapid communication must be at all times maintained between the troops and bases of supplies of all kinds, for upon its supplies depends the effective power of an army; indeed a failure of ammunition in a modern war, even for a few hours, often means the defeat, and possible surrender, of a numerous army unless it can retire rapidly.

Under these modern conditions, when a retreat is necessary, one of the most effective methods for protecting the retiring army is to destroy the communications behind it; and the most common means of doing this is to destroy the bridges as they are passed, as this effectively cuts off the supplies of the following army, which must wait until these bridges have been repaired or replaced, a work that often requires considerable time. The methods employed in destroying bridges in war time are described as follows in *The Illustrated War News*, published by the *Illustrated London News:*

Bridges may be roughly divided into three classes—namely, arched, girder, and suspension. In order to demolish rapidly an arched bridge having a single span of masonry, it is usual to fracture the crown of the arch, after which the whole thing collapses. To effect this with the least possible delay a board to which slabs of gun-cotton are fixed is suspended under the arch, in contact with the stone-work, the slabs of explosive being fired simultaneously either by a time-fuse or electricity (see No. 1 top of this page). If more time is available for preparation, a hole excavated from the roadway down to the crown of the arch is charged with gun-cotton or dynamite, a time-fuse or electric firing-cable being connected, brought to the surface, and carried to the side of the road in a suitable channel. The whole excavation is then filled in, and the road can be used as long as necessary, but the charge can be fired and the bridge destroyed at any moment. The structure in this case has nothing to show that it is mined, and may therefore be blown up if desired while the enemy is actually crossing it. If sufficient time can be given to the work, a very complete demolition of an arch may be effected (see No. 2) by simultaneously exploding three charges (*c c c*) of dynamite placed in parallel trenches cut across the bridge from the roadway down to the crown. In dealing with bridges constructed with steel girders carried on brick or stone piers, it is usual to destroy the piers by means of mines at the base (see No. 3), and to trust to the consequent fall of the girders so to damage them as to render them useless. When, however, it is thought desirable to fracture the girder itself, a charge of gun-cotton is placed below the top flange on one side, and another above the bottom flange on the other side of the center web, on a bed of clay in each case, the whole contrivance being kept in position by wooden struts. When the two charges are simultaneously exploded the girder is cut through.

To destroy a suspension bridge, it is usual to cut the cables in three places. This is done in each case by exploding two slabs of gun-cotton fixed at right angles to each other, the cable lying in the angle.

The interruption of railway traffic is a comparatively simple matter, a slab of dynamite exploded in close contact with a rail, or when fired between switch or cross-over points, causing such distortion and dislocation of the metals as to stop the passage of trains.

What "Capturing" German Trade Means

IT is an easy enough matter to speak glibly about capturing German "diverted" trade, but an exhibition which has been open at the Cutlers' Hall in Sheffield recently deeply impresses one with what it really means. The *Engineer* of London points out very aptly that one of the outstanding features of this diverted trade is the making of steel castings for shipbuilders, but that manufacturers are faced with the fact that Germany has been supplying these things to some British yards at fully 50 per cent less than the figure at which they could be made in England. "We cannot say what such castings are costing at the present moment," says our contemporary, "but it is certain that steel prices generally have considerably advanced since the close of 1914, though if the trade is to be retained after the war British manufacturers will be bound to bring their prices nearer to the German idea than perhaps they care to contemplate just now. But the exhibition at the Cutlers' Hall is an absolute revelation in the way of values. A very comprehensive collection of German cutlery has been got together by Mr. Walter Tyzack, under the auspices of the Cutlers' Company, and every article has been ticketed with the exact German selling price delivered in London, so that manufacturers who have essayed to invade German markets may see exactly what they have to fight against. The exhibition concerned the whole of the industry, as, of course, Sheffield cutlery is made from Sheffield steel. Along with razors, scissors, and knives of the highest quality, there were pocket knives at 15 cents per dozen, two-bladed penknives at 6 cents and 8 cents each, Kaffir knives from 15 cents to 32 cents per dozen, champagne knives with two blades, corkscrew and cigar-cutter, at from 60 cents to 84 cents per dozen, cast scissors at 24 cents per dozen, folding scissors from 31 cents per dozen, large cutting-out and shear scissors from 12 cents to 24 cents each, fine hollow-ground razors from $1.70 to $6.32 per dozen, and safety razors in case with an extra blade at from 6 cents each upward. Some of these prices are actually less than the cost of grinding in Sheffield, and the whole display presents a problem to the cutlery industry as to how it can so shape its future methods that the splendid opportunity now offered for capturing new markets may be taken full advantage of. Some of the lines are not worth Sheffield manufacturers' consideration, but many others are, and if it means a thorough reorganization of labor conditions, bringing them more into line with those prevailing, say, at Solingen—the Sheffield of Germany—and the introduction of the most modern machinery, even at the expense of the old handicraft idea, then it looks as if the old order must change, giving place to the new."

War and the Weather

THAT the weather is a most important factor to be considered by those responsible for the planning of a campaign has become very apparent during the last few months, for of late much has been heard of the difficulties that have resulted from heavy rains in France and the snows of the Carpathians, both of which have seriously hampered the operations on both sides. Winter conditions make the transportation of supplies and the moving of heavy guns matters of extreme difficulty that must be the subject of grave concern for the leaders, and undoubtedly every possible advantage has been taken of such advance information in regard to the weather as has been obtainable. These questions have been the most serious, although the difficulties of moving men, and their comfort in camps and trenches, have also depended greatly upon the weather. Whether Germany took into consideration the weather probabilities for the districts included in the western war zone when declaring war is not known, but this is very possible, as it is generally understood that she did not expect the war to last over two months, and the reports of bad weather in that district did not figure prominently in the news until late in September.

The Heavens in May

Determining the Difference in Longitude Between Washington and Paris

By Henry Norris Russell, Ph.D.

THE piece of astronomical work on which it seems of greatest interest to report this month is of quite a different nature from those which have engaged our attention recently, being a fine example of the use of modern methods and apparatus to obtain increased precision in the measurement of a quantity of fundamental importance. This is the difference in longitude between the Old World and the New—to be precise, that between Paris and Washington—which was re-determined by the use of wireless signals in the winter of 1913-14. French and American astronomers co-operated in the work, their observations being made in such a way that the difference of longitude could be found independently from the observations of either nationality. The results of the American parties, which alone have so far been completed for publication, are the object of our present interest.

Ever since the invention of the telegraph it has been a very simple matter, theoretically, to find the difference in longitude between any two places, however remote, which are in electrical communication with one another. It is only necessary to have standard clocks at the two stations to determine by observing the stars the errors (fast or slow) of these clocks at a given time, and then, by sending a telegraphed signal the instant of whose transmission is recorded by one clock, and of its reception by the other, to find by how many hours, minutes and seconds the clock at the eastern station (which, of course, is supposed to keep the *local* time at that point) is fast of the similar clock at the western station.

As every schoolboy knows, this difference of time can be converted into the difference of the longitudes, such as are recorded on our maps, by simply taking 15 degrees for every hour, 15 minutes of arc for each minute of time, and so on.

Theoretically, therefore, this is one of the simplest problems imaginable; practically, it is one of the most complicated and difficult to solve with high accuracy. Some features of it, indeed, may now be said to be in a satisfactory state. Present day astronomical clocks, built with every possible regard for exactness, mounted in underground vaults where the temperature is kept constant from year's end to year's end, and inclosed in air-tight cases from which much of the air has been pumped out, perform so admirably that they can be trusted to carry along the time from one night's observations to another quite as accurately as it can be found on either night by observation, though over longer intervals of weeks or months it is necessary to keep track of the clock's behavior by observations on every clear night. The transit instruments with which are made the observations of the times of passage of stars over the meridian, are also capable of very accurate construction. By a suitable plan of observation, and by continual testing of the nature and amount of their small outstanding errors of adjustment, these can be almost entirely prevented from exercising any detrimental influence. But to eliminate the human factor—the personal peculiarities of the observer behind the eye-piece—is a harder task.

It is an old story that when the observer has to watch the transit of the star over the spider-lines in his field of view, and as it crosses each one, press the key which records electrically the exact moment, the differences of "personal equation" between one man and another may be very considerable. If he waits to see the star on the thread before making the act of will which causes his hand to press the key his signal will obviously be late, and by an amount which will depend on his temperament and mental quickness. Or, realizing this, he may form the habit of pressing the key just before the star gets to the thread, and may over-correct the error and observe early. Worse than these mere "constant errors" is the probability—indeed, the practical certainty—that this error will vary with such things as the brightness of the star and the state of fatigue of the observer.

An ingenious mechanical device, the "transit micrometer," has greatly diminished these errors. It consists of an apparatus which carries a single movable thread across the field of view, and automatically signals the instant when it reaches certain fixed points in this field. The rate of its motion is controlled by the observer, who devotes his whole attention to keeping it upon the moving image of the star, leaving to the automatic part of the device the responsibility of signaling when the star and the wire moving with it reach the standard positions.

With this instrument, the personal equations of the observers are greatly reduced, though not quite abolished. Their remaining influence can be got rid of by having the observers at the two stations exchange places when half of the observations are completed. If before the exchange the combined effect of these personal errors of the observers tends to make the difference of longitude come out too great, after the exchange it will make it come out too small, and the average of the two determinations will be correct (unless, indeed, the personal equations of the observers change during the time covered by the observations, which, for experienced observers, is unlikely).

Finally, after all these difficulties have been surmounted, and the errors of the clocks at the two stations accurately determined, it is necessary to take into account the time which the telegraphic signals take in passing from one observatory to the other. On a direct overland line of reasonable length this is but a very short fraction of a second, but on long submarine cables it may be a very considerable fraction of a second before the electric current, introduced at one end, fills up—so to speak—the large electric capacity of the cable, and becomes strong enough to give a perceptible signal at the far end.

By sending signals through the line first from one end and then from the other this "transmission time" may be cleared out by taking the average, but the slightest difference in the electrical conditions in the two cases will impair the precision of the result.

Wireless transmission of the time signals possesses certain obvious advantages. The speed of transmission is that of light, and, under favorable conditions, the signals sent out from a station close to one of the co-operating observatories can be received both there and at the transatlantic station, simultaneously, and without any intervening repeating apparatus.

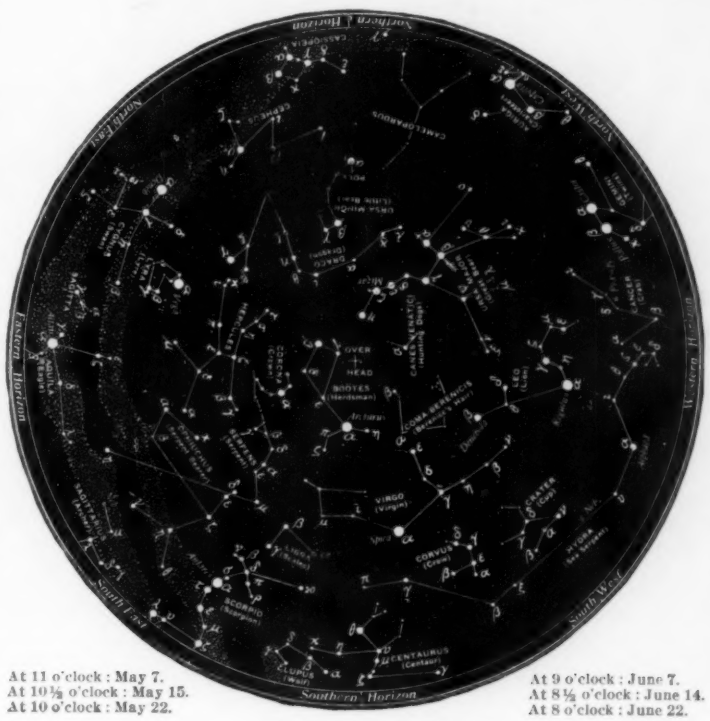
This method, in addition to all the refinements of observation previously described, and many others relating to technical, but vitally important details, has been at the basis of the recent longitude work.

The powerful radio stations at the Eiffel Tower and at Radio, Virginia, across the Potomac from Washington, were put into service and signals sent in both directions after the observers at Paris had completed their observations of the stars, and before those at Washington began theirs. Each set of signals consisted of a long series of half second "buzzes," at intervals not of exactly one second, but of 99/100 of a second so that they gradually drew ahead of the ticks of the clock used for comparison (which were made audible in the observer's telephone). The times of exact coincidence of the clock beats with the beginning of the radio signals could be easily estimated and gave the means of making a very precise comparison between the clocks at the two stations. The over-sea signals were usually very faint and difficult to hear, but satisfactory transmission of signals in both directions was secured on thirty-eight different nights between November, 1913, and February, 1914, and transmission in one direction only on fourteen more nights. The final result of all the observations makes the difference between Paris time and Washington time 5 hours 17 minutes 36.658 seconds, with a probable error of only one three hundredth of a second.

As English and French astronomers have found that Paris is 9 minutes 20.932 seconds east of Greenwich, it follows that the difference of longitude between Greenwich and Washington is 5 hours 8 minutes 15.726 seconds, with a probable error of about one sixtieth of a second. This corresponds to 77 degrees 3 minutes 55.9 seconds.

This is 0.8 second less than the value given in the American Ephemeris for 1915 and previous years. The correction corresponds to a distance of 63 feet on the Earth's surface. The probable error assigned to the new result when reduced to the same measure, corresponds to but *three and one half feet* in the whole distance between Washington and Paris.

Another evidence of the amazing accuracy of this work is that it has been possible to measure the velocity with which the wireless signals fly through the ether. From the results of the thirty-eight nights on which signals were sent in both directions the combined transmission time in both directions across the Atlantic (3,830 statute miles) was found to be 0.0437 second—almost exactly 1/23 of a second, from which it appears that the velocity of the signals was 175,000 miles per second. The probable error of this result is 16,000 miles, or about 9 per cent of the whole. The velocity of light (with which theoretically that of the wireless signals ought to agree) is 186,300 miles per second, and the observed velocity of the wireless signals agrees with this within the error of its determination.



At 11 o'clock : May 7.
At 10½ o'clock : May 15.
At 10 o'clock : May 22.

At 9 o'clock : June 7.
At 8½ o'clock : June 14.
At 8 o'clock : June 22.

At 9½ o'clock : May 30.

NIGHT SKY: MAY AND JUNE

The Heavens.

The finest region of the evening sky is now to the eastward, where Cygnus shines, just risen in the northeast, with Lyra above, Aquila to the right and Scorpio farther on toward the south. Arcturus, brightest of all the stars of distinctly reddish hue, shines almost overhead. Hercules and Boötes occupy a great space between him and the constellations previously named, Virgo is in the southwest, with Hydra below her. The stars lower down, which in our latitude rise but little above the southern horizon, belong to Centaurus, and observers in latitudes bordering on the tropics, or within them, will see below these the two bright stars of the constellation, the easternmost of which, Alpha Centauri, is our nearest neighbor in space. Leo is the most conspicuous group in the west, Gemini (now partly set) in the northwest, and the two Bears and Draco in the north.

The Planets.

Mercury is in conjunction with the Sun on the 1st, and thereafter is an evening star. During the latter part of the month he will be easily visible in the twilight, especially about the 31st, when he is at his greatest elongation. He is in the western part of Gemini and appears to be about as bright as Procyon, and superior to Castor and Pollux. Venus is a morning star, in Aries, rising about 3:30 A. M. and still very bright, although she is now 130 million miles from us. Mars is also a morning star, close to Venus. On the 14th the two planets are in conjunction, Venus being a little less than a degree to the southward. The difference in apparent brightness is very great, Venus seeming to us about ninety times as brilliant as Mars. There are several causes which combine to produce

(Concluded on page 416.)

Copyright by Brown & Dawson

A shipment of barbed wire to be used for German entanglements.

Photograph by Underwood & Underwood

Austrian howitzer shells, showing the time fuses by which

Photograph by Underwood & Underwood

British soldiers learning how to use the bayonet in trench fighting on the western front.

Photograph by Underwood & Underwood

The German Emperor on the eastern battle front cross-examining a Russian infantryman.

Photograph by Underwood & Underwood

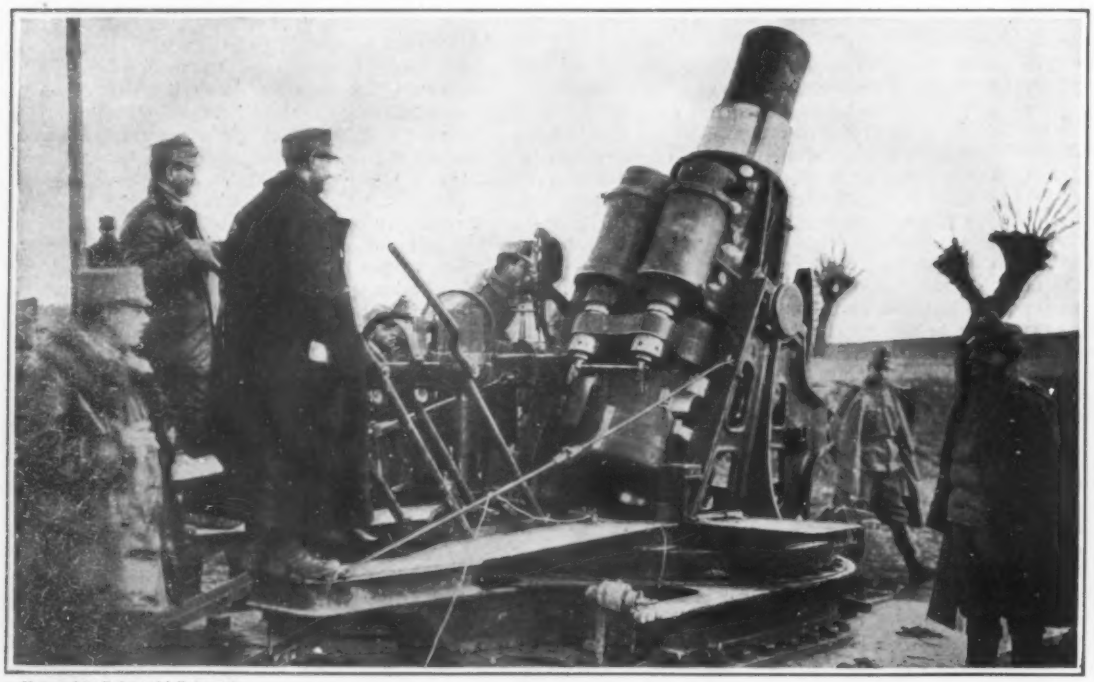
Daylight signaling with a h... auto... in no... Fran...

Copyright by Brown & Dawson

The Germans will not permit these Belgian girls to work in mines, to the detriment of their health.

Photograph by Branger

English soldiers baling ... their ... hay ... ps.



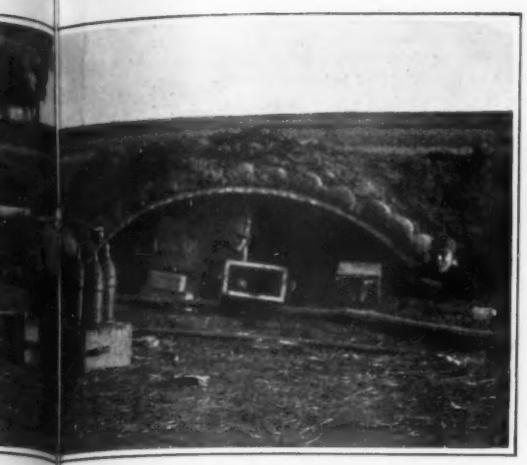
Photograph by Underwood & Underwood

The famous Austrian 30.5 Skoda howitzer, which has done wonderful work on the eastern and western frontiers.

Photograph by Underwood & Underwood

Austrian officers communic... ...elep...

RECENT PICTURES ... ...TH



...ich the moment of explosion can be accurately fixed.

Copyright by Brown & Dawson

The German army plowing for French peasants whose horses have been commandeered.

...derwood

...with a ...automobile searchlight outfit in ...rance.

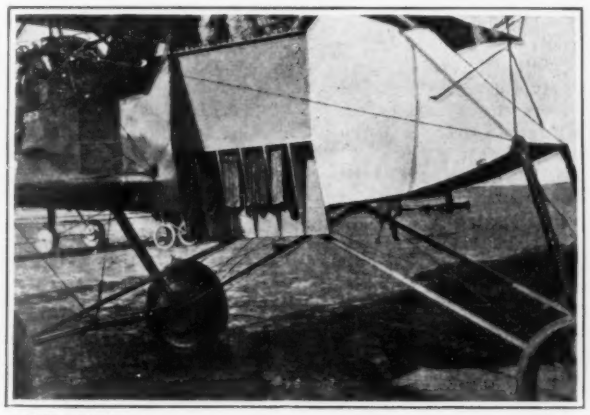
Copyright by Brown & Dawson

Printing a German paper (its name is "Hurrah") for the men in the trenches.

Photograph by Underwood & Underwood

To protect themselves from the inclement weather German soldiers have built tree houses from which they can observe the effect of artillery fire.

...aling ... their trenches with long-...ops.



Photograph by Branger

A new bomb-dropping arrangement installed on a Voisin military biplane.

...mmunic... ...elephone with the firing line.

Photograph by Underwood & Underwood

This photograph, taken at Przemsyl, shows how the gun is lowered after it has been fired without exposing the crew.

...RES ... ...TH FIGHTING FRONTS

Shoe-button Attaching Machine

A PATENT has recently been issued on a machine for attaching buttons with wire staples, which possesses many novel features and several improvements over present machines for performing this work. The new machine automatically makes, drives and clenches the staples, fastening the buttons to shoes, gaiters, leggins, and other articles. One of the advantages of the new machine is that it will take buttons of various sizes. If it be desired to attach a few buttons of a different pattern from those with which the magazine is stocked, the chute that leads from the magazine may be cleared by tilting it, so that the buttons will flow by gravity back into the magazine and then buttons of any desired design may be introduced into the chute by hand. The mechanism which feeds the wire to the staple-forming parts is arranged to operate only when there is a button in position to receive the staple.

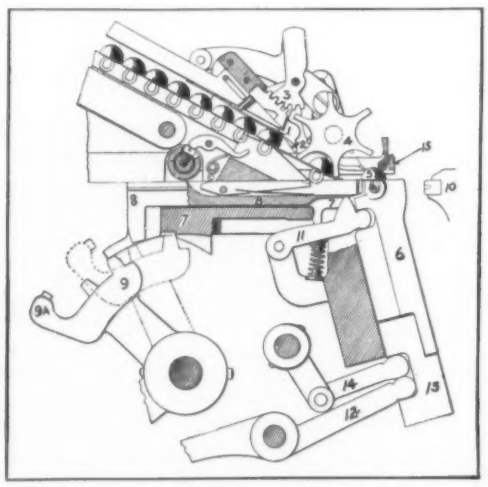
The accompanying photograph gives a general idea of the machine, and the method of using it to attach buttons to shoes. The machine is operated by depressing a pedal. In the magazine there is a pick-up device consisting of a pair of plates separated sufficiently to form a slot in which the shanks of the buttons are received. At each operation of the pedal the pick-up device is lowered to the bottom of the magazine or hopper, so that the buttons will fall upon the two plates, and some of them at least will drop into proper position, with their shanks in the slot. As soon as the pick-up device reaches the bottom of the magazine, the magazine itself drops, agitating the buttons therein and causing them to fall into the pick-up device. This also serves to jar off the pick-up device such buttons as are not properly located with their shanks in the slot. Then the pick-up device rises, lifting the magazine to the position shown in the photograph, and the buttons slide out of the pick-up device into the chute.

In the accompanying drawing is a sectional view of the mechanism which makes, drives and clenches the staples. It will be observed that the last one of the row of buttons in the chute is retained by a leaf spring 1. The forked ejector slide 2 is in its forward position, having just been operated by the mutilated gear 3, to push a button out of the chute. This button is detained by the starwheel 4, while the button 5 is being affixed to the shoe. The shank of button 5 rests in the staple former or die 6, and the wire has been threaded through the shank of the button. By mechanism not shown in our drawing, the wire is cut off to the desired length, and then it is bent forward to form a staple by means of a pair of fingers on the slide 7. These fingers, however, do not show in the drawing because the section is taken through the center of the slide, and the farther finger is largely concealed behind the staple driver 8 that operates between the fingers. The staple former is moved forward by the bell crank lever 9, which is actuated by the foot pedal. Further motion of this bell crank lever brings the extension 9A against the staple driver 8, causing it to push the button forward and force the staple point through the article to which the button is to be attached and against the anvil or clenching die 10. Of course before the staple driver can operate, the staple forming die 6 must be lowered out of its path. This is accomplished by means of a member 11, which engages the die 6. When the driver 7 is moved forward, it rides over the upwardly projecting tooth of member 11, depressing the member and with it the die 6.

Most of the mechanism that feeds the wire to the buttons is cut away in our sectional view. But the actuating lever may be seen at 12, also a slide 13 that it raises and lowers. The recess in slide 13 which the lever 12 engages is so large that the lever may swing through its full sweep without lifting the slide. But a filler is introduced into the recess in the shape of an arm 14, which is connected by a system of levers with the buttonholder 15, so that when there is a button in position to receive the wire, the buttonholder 15 is raised, introducing the filler 14 into the slide 13. Then when the lever 12 swings upward, it will lift the slide 13, and thread the proper length of wire through the shank of the button in the die 6. Should there be no button in the die, the arm 14 would be retracted, and the lever 12 would operate idly without lifting the slide 13. Thus no wire would be fed to the mechanism to cause clogging or imperfect working.

The inventor of this machine is Mr. Benjamin Kotkovsky of Brooklyn, N. Y.

Attaching shoe buttons by machine.



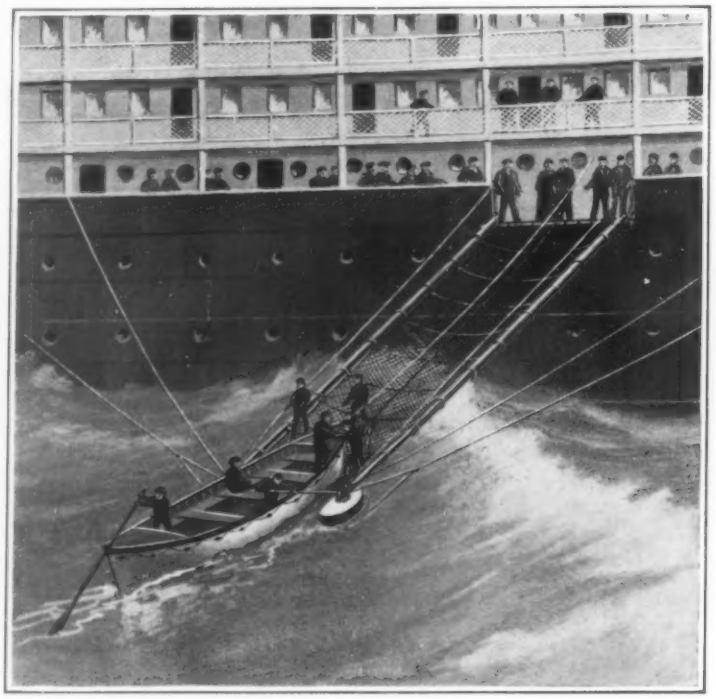
Details of the driving and clenching mechanism.

Emergency Marine Gangway

WHEN the ill-fated "Volturno" wallowed helplessly in mid-ocean, her terror stricken passengers huddled on the afterdeck to escape the inferno of flame that raged within her, there were plenty of would-be rescuers about, but they were powerless to reach these unfortunates owing to the high seas. Only those who had courage to throw themselves into the ocean and be picked up by a rescue boat had any chance at all while the storm raged, and then the daring sailors who went out in their lifeboats after these men and women had the greatest difficulty in disembarking the shipwrecked ones from their lifeboats to their vessels. Not many were saved even in this way, and for long hours the ships stood about the wreck hoping that the sea would subside and give them a chance to deliver the unfortunate men and women.

The ordinary method of lowering a lifeboat over the side of a vessel is attended with grave danger when a heavy sea is running, and it is not without danger even in comparative calm. Owing to the heavy load of a boat filled with passengers, and the great height of the boat deck above water, there is always the possibility that the boat may swing like a giant pendulum against the hull of the vessel and be crushed before it has a chance to reach the water.

Pondering upon these conditions, Capt. Arthur M. McGray has hit upon the scheme of using an inclined way, such as shown in the accompanying illustration, for the safe disembarking of passengers and crew from a ship in distress. The same device can also be used to enable the passengers to disembark from the lifeboats and board the rescuing ship.



Emergency gangway for embarking and disembarking passengers.

This system has the merit of being extremely simple and consisting largely of such spars and tackle as any ship is provided with. Two booms are used of a length which will vary with conditions. They should be long enough to provide an incline of about 35 degrees from the water to the gangway. At the outboard end of each boom is a float large enough to buoy up the boom and make it ride on the surface of the water. These booms support a wire net which serves as a gangway down which the passengers and crew may make their way to the lifeboats. The booms are kept properly stretched apart by means of guy ropes as shown in the illustration. The network is provided with sufficient slack at the outboard end to permit the stem of the lifeboat to ride upon it. In this way the lifeboat may be held firmly moored to the rescue net.

Ordinarily a ship in distress lies in the trough of the waves, and the disembarking of passengers takes place on the leeward side. The action of the waves is then toward and from the ship, and by keeping the lifeboat bow-on to the rescue net it is in the best position to ride the waves. It will be noticed that the floats also are of such shape as to ride the waves best in this position, for they run parallel to the booms they support. The inner face of each float is flattened so as to clear the lifeboat. Of course the lifeboat will rise and fall on the waves, but so will the net, hence there will be no interruption to the embarking or disembarking of passengers. The booms are each provided with a set of rings and the net is readily attached to them by means of snap hooks. It is then drawn out to the end of the boom by means of suitable tackle. When not in use the net may quickly be removed, and the booms and boats together hoisted on board. With slight alterations the ordinary cargo booms of a ship may be utilized in this equipment.

Capt. McGray has recently secured patents on this life-saving apparatus, and he informs us that when he showed the invention to the captain of one of the rescue ships that took over a hundred people from the "Volturno," he said that it was the very thing he was trying to devise during those long hours of helpless watching, but he had not quite been able to figure it out.

Using the Talking Machine to Teach Music

AS the result of a system of musical time-recording records for talking machines lately devised by Jules Louis-Elson of Far Rockaway, N. Y., the prospect of after-school practice hours on the piano stool may be lightened for juvenile music students. Mr. Louis-Elson's automatic "coach" will hold no terrors of scoldings or rapped knuckles for "young hopefuls," but will be found to be of infinite patience and ever-ready to repeat the count or an example of instruction.

The principles contained in what the inventor terms his "scenario" may be interpreted on six double-disk talking machine records, or, the same result may be obtained in a condensed form by combining all of the musical counting or time recording on one record only. In the latter case, the 1, 2 count runs in one endless groove, or circle, on the record; the 1, 2, 3, on an inner groove, and so on until the counting is complete with six separate circles on one record. This principle is applicable also in making two or three records of the six methods of musical time recording, or counting, if so desired.

On one side of the record are examples cited by the instructor in oral text; on the other side is the oral count of beats, as: 1, 2; 1, 2, 3; 1, 2, 3, 4, etc. A concluding specimen of the oral instruction text is as follows: "For example, let us take the Presto form (the record plays twelve bars). Now, when you consult the printed music you will notice that the quarter, or C (as it is printed), is barred. This serves to indicate that one should count in two. The record now sings as a teacher does the previously played bars of the Presto, emphasizing the count: 1, 2; 1, 2. Thank you."

RECENTLY PATENTED INVENTIONS

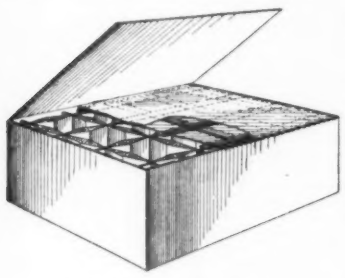
These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Electrical Devices.

TUNING TRANSFORMER FOR WIRELESS SYSTEMS.—R. R. GOLDTHORP, 204 High St., Hartford, Conn. This invention relates to a tuning transformer for wireless systems and relates more particularly to a transformer of that type having relatively movable primary and secondary coils in connection with means for varying the effective lengths of the coils to obtain a wide range of tuning capacity.

Of Interest to Farmers.

FILLER FOR EGG CASES.—C. P. DALY, 2134 Amsterdam Ave., New York, N. Y. This invention relates to fillers for egg cases or carriers and more particularly to an improved double-walled filler of such construction that



FILLER FOR EGG CASES.

shocks incident to the shipping and handling of eggs or like fragile articles will not cause the breakage or injury thereto as is now commonly caused.

DESICCATING APPARATUS.—E. E. ELDREDGE, No. 2 Chevy Chase Apt., Chevy Chase, D. C. An object here is to provide a device by means of which milk or other similar fluids may be economically and effectually dried. The invention provides means for drying milk which will do away with complicated apparatus and which can be run continuously, thereby obviating the necessity of frequent delays for charging or discharging.

Of General Interest.

DIAPHRAGM SETTING FOR PHONOGRAPH REPRODUCERS.—F. W. THOMAS, New City, N. Y. By this invention full tonal effects are obtained from the vibrations of the diaphragm and superior reproduction rendered possible, this through the use of reliable gaskets between which the peripheral edge of the diaphragm is clamped with a uniform and practically permanent compression, so that rattling of the diaphragm is positively prevented.

TOILET DISPENSING CABINET.—A. F. LESLER, care of Sanitary Co., 30 Church St., New York, N. Y. This invention provides a structure which may be used in a number of ways, and also used to dispense a number of different articles so that the device may be utilized in toilet rooms, lavatories and other places where toilet paper or towels are desired.

NON-REFILLABLE BOTTLE.—J. A. MATSON, 344 Greene Ave., Brooklyn, N. Y., N. Y. The inventor provides a bottle with a cup in its neck and having a central valve opening in which is normally disposed a plunger with a stem disposed in a central opening, in a guide having lateral openings through which the liquid may flow from the bottle and air may flow into the bottle to replace the liquid which has flown therefrom.

AMALGAMATOR.—J. C. WOOD, care of E. N. WOOD, 1156 Monadnock Bldg., Chicago, Ill. This invention relates to improvements in amalgamators, and has for an object to provide an improved structure for causing the gold or other mineral matter to be separated while the aggregating matter is moving continually through the device.

HAIR TRANSFORMER.—J. J. TEUGLER, 1523 Sherry St., Philadelphia, Pa. The invention relates to hair dressing, more especially false hair, and the main object thereof is to provide a transformer for women's hair, whereby the entire head-dress may be placed in position or removed therefrom, as a unit.

Hardware and Tools.

MOWER.—G. P. HELFRICH, 976 Fox St., Bronx, N. Y., N. Y. This mower cuts with a single knife blade. It will cut grass of any height, and also cut close to a wall or fence. There being no friction between blades, the mower will cut a wider swath than other mowers, with the same amount of power.

POT AND COVER LIFTER.—K. PROCHASKA, care of Berthold Lechner, 25 W. Broadway, New York, N. Y. The invention relates to tools for use more particularly in connection with cooking utensils or camping outfits. It provides an implement of cheap and strong construction, the same being provided with various engaging devices at its ends whereby the implement is adapted for numerous various uses.

DENTAL ENGINE TOOL GUARD.—F. FISCHER, care of Dr. C. Myron Kaletsky, 297 Fulton St., Jamaica, N. Y. Among the principal objects which the present invention has in view are: To provide a guard arranged to prevent the contusion of flesh between the said guard and the abrasive tool; and generally, to provide a guard and holder therefor having a compact structure and a neat appearance.

WIRE STRETCHER.—A. B. DILL, Lakin, Kan. The invention relates to wire stretchers and the object is to provide a device of this character which is light and compact, which may be readily set up and taken down before and after the stretching operation, and which will be effective and durable in use for the purpose it is intended.

CARPENTER'S TOOL.—W. H. BARRON, Jr., and C. LESEMAN, 203 N. Arizona Ave., Atlantic City, N. J. This improvement relates to tools for the use of carpenters, stair builders, cabinet makers and others, and the main object is to provide a tool which is adapted for a wide range of use as a marking gage, and also as a scriber, to mark work on regular or irregular lines.

Heating and Lighting.

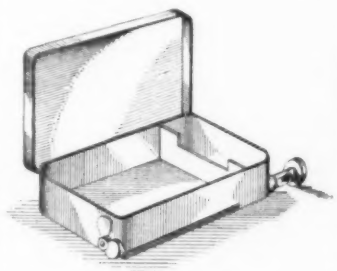
AIR FEED FOR FURNACES.—E. WINANS, New York, N. Y. This structure may be readily inserted into furnaces for supplying the heated air thereto so as to cause a better combustion of the gases evolved from the gases in the furnace. The air feeding device may be built into the furnace or may be added to the furnace at any time.

Household Utilities.

WATER CLOSET.—F. SCHUH, 25 Jarvis Ave., Trenton, N. J. The improvement provides a closet arranged to combine the bowl and tank in one single integral structure, to render the closet exceedingly sanitary, to avoid leakage, to insure an effective flushing of the bowl and drainage of the accumulated moisture or overflow.

Machines and Mechanical Devices.

CIGARETTE ROLLING MACHINE.—J. E. ROACHE, 91 Clinton Ave., Brooklyn, N. Y., N. Y. The object of this invention is to provide a machine arranged within a tobacco container to allow the production of a cigarette without danger of spilling the tobacco, to permit of placing the proper quantity of tobacco

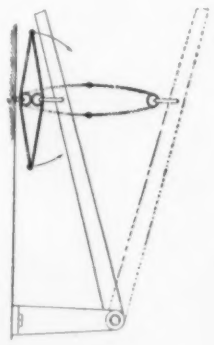


CIGARETTE ROLLING MACHINE.

into a forming or filling tube, to uniformly distribute and pack the tobacco in the said tube, to wrap the wrapper around the tobacco in the filling tube, and to allow of finally ejecting the finished cigarette from the tube without requiring opening of the container.

VARIABLE SPEED GEARING.—P. D. SMITH. Address Francis G. Wilson, 140 Pacific Ave., Santa Cruz, Cal. The invention relates more particularly to a gearing adapted to automobiles and other machinery, and provides means whereby rotation may be transmitted from a driving to a driven member at a variety of speeds ranging in a driven member from a revolution for every revolution of the driving member down to a standstill when the driving member is at full speed.

SPRING.—F. C. GIVENS, Tuolumne, Cal. This invention has reference to springs, particularly to extensible springs having a contractile effect, and one of the main objects thereof is to provide such springs which allow



SPRING.

extension up to a definite point, but beyond which will result in breakage of the parts. The invention provides such springs which will always return to initial position when relieved of tension.

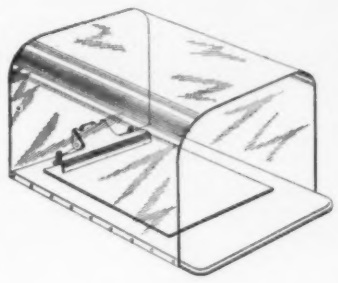
GRINDING MILL.—F. T. H. GOODWIN, Erskine House, Longton, Stoke-Upon-Trent, England. The object here is to provide means for the grinding or milling of potters' and like materials whereby the same are prepared for the manufacture of, for instance, pottery. The feeding of the material and the water is regulated to suit the rate of outflow and the degree of fineness to which the material is to be ground and the required fluidity of the slip or the ground and mixed product.

AUTOMATIC DOOR OPENING AND CLOSING APPARATUS.—G. M. BEERBOWER, 75 Harmon St., Pelhamwood, N. Y. The invention has reference to an opening and closing apparatus for doors or gates of that type whereby the door or gate automatically opens upon the approach of a vehicle and automatically closes upon the departure of the vehicle.

AUTOMATIC STUFF BOX FOR PAPER MACHINES.—W. P. FEENEY, 32 Elm St., Hudson Falls, N. Y. The invention provides a stuff box for use in paper machines having means actuated by a float for regulating the flow of the stock to a paper machine and for returning the surplus stock to the chest. Means provide for returning the stock to the chest before it reaches the float.

Railways and Their Accessories.

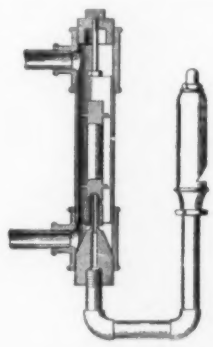
CLIP BOARD SHIELD.—J. A. LEE, P. O. Box 194, Brigham, Utah. The invention provides a transparent shield and covering adapted for attachment to a clip board, that is to say, to a base provided with a clip. By a clip board, it is to be understood, is meant



CLIP BOARD SHIELD.

any equivalent base having means to hold paper to be written upon. It is particularly applicable to a clip board for holding a conductor's train book, or a yard checker's train sheet or the like, while checking trains in the rain, snow, or wind.

AIR SIGNAL VALVE.—E. J. ERICSSON, 1352 Guerrero St., San Francisco, Cal. This inventor provides a valve in the train signal air line which permits the actuation of a signal when a relief valve at one of a plurality of points is opened, said signal preferably being in close proximity to a locomotive engi-



AIR SIGNAL DEVICE.

neer or to a motorman of a motor car or train. The valve prevents the signal actuation when the train line is closed, regardless of the pressure of air in the train line. The valve permits the actuation of the signal of a portion of the air rushing from the air reservoir to an open relief valve.

RAIL TIE AND FASTENER.—W. A. GUPTILL, Maidstone, Vt. One of the principal objects of the invention is to provide a cross tie with a rail fastener having means for securely locking the track rails against the tie. An im-

RAIL TIE AND FASTENER.

portant object is to provide a fastener adapted to clamp the tie so firmly to the rail that all vibration will be reduced to a minimum, and also to provide means for taking up wear between the fastener and rail.

Prime Movers and Their Accessories.

INTERNAL COMBUSTION ENGINE.—J. KEISTER, Steubenville, Ohio. The invention relates to engines of the four-cycle type, and particularly to engines of that character wherein the admission of the explosive fluid and the exhaust of the spent gases are controlled by a single tubular valve which surrounds the piston of the engine.

METALLIC PACKING FOR PISTON RODS.—J. BADEKER, care of Omaha Machine Works, 612 South 14th St., Omaha, Neb. This inventor provides a packing which will not require the numerous repairs that are necessary in the ordinary packing of this type, but which will continue to work efficiently without the necessity of repair until such time as is necessary for replacing all the packing itself.

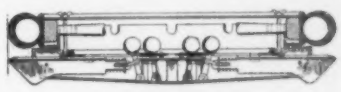
INTERNAL COMBUSTION ENGINE.—F. D. CALKINS and A. C. JOHNSON. Address Gray Motor Co., Detroit, Mich. The invention has for its object the provision of means in connection with a rotary valve for controlling the admission and exhaust of the motive fluid, for holding the valve yieldingly on its seat, while permitting it to rotate, and for compensating for wear in the valve or in the seat.

Pertaining to Recreation.

GAME.—G. B. SMITH, Waldwick, N. J. The invention relates particularly to a game adapted to be played by a number of players, and provides an arrangement whereby all of the players have an equal chance but where an unwise move by an opponent will be liable to produce disastrous consequences.

Pertaining to Vehicles.

ATTACHMENT FOR AUTOMOBILES.—F. R. NYBERG, 104 North 8th St., Lamar, Col. This improvement is designed to be attached to the wheels, and wherein a housing is provided capable of attachment to and removal from the wheels and carrying a series of dogs



ATTACHMENT FOR AUTOMOBILES.

arranged in spaced relation and mounted for movement beyond the periphery of the wheel and normally lying within the periphery of the wheel, and wherein other mechanism is provided in connection with the dogs for extending the dogs at predetermined times.

SPRING WHEEL.—G. J. MURPHY, Barradero, Buenos Aires, Argentina, S. A. The invention relates to a spring wheel adapted for use on automobiles and other vehicles, and more particularly relates to a wheel in which the tire section is in the form of an annular spring coil, there being a separate hub section and spoke elements to form a connection between the hub section and the coiled spring tire.

BRAKE BLOCK HOLDER.—P. KRUEMLISG, Maher, Colo. The invention relates to a holder for brake blocks or shoes, and the object thereof is to provide a device of this kind, which will permit of the utilization of any kind of a block to form the brake shoe, and which can be readily mounted upon the beam by means of which the brakes are applied.

Designs.

DESIGN FOR A CLOCK FRAME.—J. E. STEINMEIER, Address C. H. Osborne, care Western Clock Co., 375 Broadway, New York, N. Y. In this ornamental design for a clock frame the frame is upright in form and outside the dial the effective features comprise cupids, scroll work, and flowers.

DESIGN FOR A DOLL.—CLAIRE AVERY, 232 E. 15th St., New York, N. Y. In this ornamental design for a doll the figure lacks arms and legs. A plain baby face is surrounded by a neat shaped head covering capped by a bow, and a dress with a single flounce hangs from the doll's neck.

DESIGN FOR A PARASOL.—O. M. ARNOLD, care of Arnold, Schiff & Co., 85 Fifth Ave., New York, N. Y. In this ornamental design for a parasol, the article has a long, graceful handle and rod; on the latter is a frame of very graceful form, its cover ornamented with a highly original flounce effect.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(13056) G. C. A. asks: What is the mechanical equivalent of light? That is, is the candle-power a measure of energy or merely a measure of comparative brilliance? In the latter case, what is the unit of light energy, and what is its mechanical equivalent? What is the latest theory of light? What, if any, is the relation between light and electricity? What is the relation between the static units of electricity and the electromagnetic units? What is the latest generally accepted theory of electricity? A. The candle-power is a measure of brilliancy. It is by law in America the amount of light given by a candle burning 120 grains of wax per hour. They are made six to the pound. There is no mechanical equivalent of light in the same sense as there is a mechanical equivalent of heat. The same amount of power does not always yield the same amount of light. The efficiency of an arc light is much greater than that of the incandescent lamp, and so of other illuminants. The accepted theory of the nature of light is that it is an electromagnetic phenomenon. It is transmitted from the sun to the earth by the agency of the ether of space. This is known as Maxwell's Electromagnetic Theory of Light. The ratio of the electrostatic to the electromagnetic units is a velocity, and it appears to be the velocity of light, as it should be if Maxwell's theory is correct. For this interesting topic we would suggest Thompson's "Elementary Lessons in Electricity," which we can send for $1.40 net, postpaid $1.55. The Electron theory is now generally accepted as best explaining the phenomena of electricity. You will find a simple explanation of the electron theory in our SUPPLEMENT 1861.

(13057) C. C. S. asks: Kindly answer under Notes and Queries the following: A asserts that there is nothing that will change its real essence by a change in its degree. B says things will. Who is right? A. In a general way, a difference in degree can be made to disappear by an increase or diminution of the kind of thing involved. If a reasonable profit is right an enormous profit is wrong, and the larger the profit beyond reason the greater the wrong. The difference here between right and wrong can be removed by diminution till the wrong has disappeared. The difference in degree between a rich man and a poor man can be made to disappear by the addition of money to the poor man's bank account. A difference in kind cannot be made to disappear by addition or subtraction. A mountain cannot become a river by any change in degree, while a large mountain can be made into a small mountain by taking earth away from it. These illustrations will convey the essential difference between the two terms difference in degree and difference in kind.

(13058) H. F. W. asks: As a regular reader I would be glad if you would kindly tell me about the bright star visible in the southeast in the early morning in this locality. I am told it is the Star of Bethlehem and that its appearance indicates some important event is about to occur upon the earth, and that its past history has borne this out. A. The bright "star" in the southeast in the early morning hours is the planet Venus on her regular course around the sun. She is quite unconscious of the interest her appearance awakens and is entirely disconnected with the Star of Bethlehem. She comes into this position at this hour of the night with regularity and her appearance does not portend anything whatever with regard to the earth or its history.

(13059) H. C. B. asks: During a recent experiment, in which I was using mercury in a glass vial to make an electrical contact in a circuit, I was at a loss to account for the presence of mercury on the bench beneath the switchboard. In order to prove where this leakage was coming from I was finally obliged to remove the vial and contacts until I made the experiment as shown on rough sketch here inclosed. I have proven that the mercury creeps up the copper wire and drops from its end as if it were a wick. In this experiment there is no electrical circuit and no other condition except those as shown. Can you tell what causes this condition and how to avoid it? A. We have tried the experiment with a clean copper strip and a copper wire in mercury, and have not been able to produce any climbing of the mercury up the copper. If there is any such action it is due to capillarity. Mercury might climb clean copper, but we do not know how high it would go. It would climb a cable of twisted wire much better than a single wire or a flat strip.

(13060) R. W. L. asks: In the absence of a question column, I am sending this communication to you in the hope that it will be answered by means of the inclosed envelope. For over a year I have been trying to get some complete information regarding the element selenium. I want to know how the selenium cell is made, in order to perform the experiments where its electrical conductivity varies with changes in light. I have inquired at the university (where I am a student) and looked it up in the physics library, but have been unable to learn how these cells are made. I have come to the conclusion that the SCIENTIFIC AMERICAN would know if anyone does, and I certainly would appreciate anything you could tell me on this subject; either the information itself, or where such information could be secured. A. We have published many articles about selenium and its uses. Among them have been several giving detailed plans for making selenium cells. You will find these in our papers as follows: SCIENTIFIC AMERICAN SUPPLEMENT Nos. 1430, 1719, 1912, 1881, 1882, 1883, 1897, 1914, 2041, 2046, and the SCIENTIFIC AMERICAN Vol. 107, No. 21, and Vol. 112, No. 9. You will find the information in these papers complete.

(13061) E. E. H. asks: 1. How are scales made and circles graduated? I wish to graduate a circle for amateur use of a telescope, accurate enough for finding such objects as the telescope can enable me to see. A. The graduation of a scale, either on a straight edge, or a circle, is best done by means of a screw, as perfect a screw as can be constructed. The surface to be ruled is moved under the graving point, or the point over the surface, usually the former, and the graduations cut in one at a time. If the screw has 10 turns per inch, and the disk upon the head of the screw is divided into 100 equal parts, a complete turn of the screw moves the graving point along 1/10 of an inch, and turning the head around one division moves the graving point 1/100 of 1/10 of an inch, or 1/1000 of an inch. In this way any desired scale can be graduated on a bar. A circle is divided into degrees by means of a circle upon the outer edge of which gear teeth are cut. A screw meshes into these teeth. The screw is turned enough to move the circle 1/360 of its circumference, if the degrees are to be cut in the circle to be graduated. A line is graved with the graving point, and the process is continued till the work is finished. The accuracy of the whole depends upon the accuracy of the screw. The Ency. Brit. 11th edition, vol. xii, pages 312-314, contains a very clear account of the development of the Dividing Engine, with a cut of one. You may perhaps graduate a circle well enough for your purpose by first dividing it into quadrants, and then into eighths by bisecting the quadrants. The sections of 45 degrees can be divided into thirds, or 15 degrees, and these into thirds, or 5 degrees. Then you can divide these sections into single degrees and half degrees. In this way there will not be so much accumulation of errors as there will be if you try to space off a large section of the circle into a single degree with dividers. 2. How are verniers constructed? A. You can make a vernier to read to one minute for your circle by taking 29 half degree spaces of the circle and dividing this space into 30 parts for the vernier. The vernier will then read to one minute. By making 30 vernier spaces equal to 29 scale spaces, each vernier space is 1/30 of a scale space shorter than a scale space. The scale division is a half degree, or 30 minutes, and the vernier division is 29 minutes or one minute shorter than the scale division. With such a vernier readings to one minute of arc can be made. The vernier is fully described in the Ency. Brit. 11th edition, vol. xxvii, page 1032, so far as straight lines are concerned, and we have given a description of a vernier for a circle. We trust this will clear up some of your difficulties. 3. How can a ball fall to the east of the point from which it is dropped when the text books say it will fall toward the center of the earth? A. Your doubt as to the fact of balls falling to east of the point from which they are dropped has been answered in Query 13054, issue of March 20th, 1915. The earth does not turn under the ball as it falls. By inertia the ball retains the eastward velocity of the point from which it started, and as it falls to a place which is rotating slower, it will be moving faster to the east than the place to which it has come. For this reason it falls toward the east. It is not the same with an ordinary balloon which moves with the air and has only the motion of the earth and the air to give it motion. It simply floats with the wind, and has no power to move itself. It has simply the velocity of the place where it happens to be. A ball dropped in a car falls perhaps six feet. In that distance there is no visible deviation. Several hundred feet are necessary to produce a measurable deviation. If the earth turned under a balloon it would leave the balloon to the west of the place from which it started since the earth turns toward the east and the ball in falling turns to the east faster than the earth does at the level to which it has fallen. We hope this is clear. 4. Why do races living in hot climates have black skins if Nature protects them from heat? A. The question of black people in the Torrid, and white polar bears in the Frigid Zone, is perhaps not simply one of absorption of heat. Black is also the best color to radiate heat, hence the black man is able to get rid of his heat to the highest degree. There is probably much more to it than this. The annoyance and injury from excessive light is probably due more to the ultra-violet rays of the sunlight than to the heat rays. The black pigment of the negro is a defense against these rays. The white man who migrates to the Torrid Zone in a few generations develops a dark pigment which adapts him to live under torrid conditions. There can be no doubt that adaptation to environment has brought about the condition and that the black pigment is an advantage and not a detriment to the people in whom it is developed.

NEW BOOKS, ETC.

ANIMAL EXPERIMENTATION AND MEDICAL PROGRESS. By William Williams Keen, M.D., L.L.D., Professor Emeritus of Surgery, Jefferson Medical College, Philadelphia. With an Introduction by Charles W. Eliot, LL.D., President Emeritus of Harvard University. Boston and New York: Houghton Mifflin Company, 1914. Price, $1.75.

Dr. Keen has been one of the ablest champions of what is improperly called vivisection. He has done his share in spreading among the multitude the truth about animal experimentation and the great benefits that scientific men and humanity have derived from the use of the lower animals in the laboratory. The book is a series of papers which have been published by Dr. Keen in medical and other journals and which are here arranged in chronological order. If there is much repetition as a result of the author's desire to reprint the papers exactly as they appeared, there is also much force in his argument that "a potent reason for the repetitions is that they were intended to meet the constantly repeated misstatements by the opponents of experimental research in spite of public exposure of these misstatements." To those who wish an exposition of the unreasonableness, inaccuracy and indifference to truth and justice manifested by anti-vivisectionists, this book may be heartily recommended. Coming as it does from an eminent surgeon and a man of humane feelings it should be read by everyone who takes any interest whatever in the present campaign to restrict scientific men in their efforts to relieve the sufferings of humanity.

THE NEW BUSINESS. By Harry Tipper, President, Advertising Men's League, New York. Published by Doubleday, Page & Co. for the Associated Advertising Clubs of the World. 1914. 8vo.; 391 pp.; illustrated. Price, $2 net.

The author confesses that commerce has always held for him the interest which attaches to a great primary force. It is probably this attitude which, taking possession of his pen, injects an almost breathless suspense into his work. Yet here is no popular tract on the romance of this, that, or the other. Any man of fair intelligence may understandingly absorb its facts, but these go to the very heart of advertising, marketing, selling—and back their statements with concrete examples. There is a short review of the old conditions of hand labor; then a sketch of modern conditions which followed upon the advent of steam. The second section of the work deals with finance and marketing costs, including a study of the concentration of money control and its effects. Section 3 takes up the factors in marketing cost. Sections 4 and 5 bear upon organization, training, and specializing. The final division concerns itself with good-will, with buying habits, and with future tendencies. The author has prepared graphic charts which place vital facts and phases of manufacturing, distribution, and competition before the reader.

THE CHEMISTRY OF FAMILIAR THINGS. By S. S. Sadtler. Philadelphia: The J. B. Lippincott Company, 1915.

This book differs markedly from the usual popular presentation of chemistry. It begins originally enough, not with the usual cut-and-dried elementary exposition of chemical principles, but with the part that chemistry has played in nature. Not until the natural aspect of the subject has been dismissed and the importance of an exact knowledge of the composition of matter pointed out, are such subjects as atoms and molecules, acids and organic and inorganic substances discussed. Nor is the book confined entirely to chemistry. The chapter which is entitled "The Chemistry and Production of Light" is very largely a discussion of physical principles and takes up subject matter which properly falls within the scope of this book, but which most chemists would probably omit. Chemistry and physics are nowadays so intimately interwoven that it is difficult indeed to exclude physics from a popular text-book on chemistry. Generally we find heat combustion, insulation, air, oxidation and ventilation taken up not only from the chemical but from the physical standpoint. The range of the book is wide indeed. The chemistry of the earth's evolution, soil and its conservation, food elements and food classes, animal feeding, fermentation, chemistry of the body, paper and textiles, leather and rubber, silicious substances in glass—all these find a place in the book. Taken as a whole the book may be regarded as a good example of what popular scientific writing should be.

THE CURVES OF LIFE. Being an Account of Spiral Formations and Their Application to Growth in Nature, to Science and to Art. With Special Reference to the Manuscripts of Leonardo da Vinci. By Theodore Andrea Cook. With 11 plates and 415 illustrations. New York: Henry Holt & Co., 1914.

It is difficult indeed to describe the impression which is left upon the mind by this remarkable treatise. The book of nature is opened at a new page, as it were, and a new chapter is presented for perusal. This is not the work of a mystic but the fruition of twenty years' study of spiral formations as they are exhibited in shells, plant leaves, seeds, crystals, clouds, tendrils, animal horns, the cochlea of the human ear and the umbilical cord, bones, the intestines, fingerprints, the muscular fibers of the heart, nebulæ, and the artistic works of great painters and sculptors. The underlying cause of beauty in art and in nature is found to be the same—found to be the logarithmic spiral. With the assistance of Mr. Mark Barr and Mr. William Schooling, these spiral formations have been considered mathematically. It seems that the spirals are generally of one type, and that their form is closely connected with the geometrical series 1, ϕ, ϕ^2, ϕ^3 ..... ϕ^n. In this the quantity ϕ is such that the sum of any two consecutive terms is equal to the next. Thus considered, ϕ must be equal to 1.618033... or -0.618033.... It is amazing how generally applicable is this formula to works of art, such for example as "The Laughing Cavalier" by Frans Hals, the "Venus" of Botticelli, the "Last Supper" of Leonardo, the "Ulysses Deriding Polyphemus" of Turner, and even to some of the works of Burne-Jones. Apparently the logarithmic spiral, judging from the numerous examples quoted from nature by Mr. Cook, is the nearest mathematical expression we can use for the relation of form to growth. The idea of logarithmic spirals as applicable to growth did not originate with Mr. Cook, as he clearly admits. We find it, for example, in Mr. A. H. Church's discussion of Phyllotaxis. The critique of the "Life-labored Utterances of Passionate Thought" of Leonardo da Vinci is one of the most eloquent and sympathetic that has ever come to our notice. Indeed, the whole spirit of Leonardo dominates the work. Written in clear graceful English with a delightful personal touch, the book is a pleasure to read.

ELEMENTARY ELECTRICITY AND MAGNETISM. A Text-book for Colleges and Technical Schools. By William S. Franklin and Barry Macnutt. New York: The Macmillan Company, 1914. 12mo.; 174 pp.; illustrated. Price, $1.25 net.

ADVANCED THEORY OF ELECTRICITY AND MAGNETISM. A Text-book for Colleges and Technical Schools. By William S. Franklin and Barry Macnutt. New York: The Macmillan Company, 1915. 8vo.; 300 pp.; illustrated.

The first text-book is an elementary presentation of the magnetic, chemical, and heating effects of the electrical current, of the conditions and phenomena of induced electromotive force, and of electric charge and the condenser. The argument is energetic, the diagrams simple, and the examples practical. This general description also applies to the "Advanced Theory of Electricity and Magnetism," which carries the student over the same general field, but to a wider and deeper purpose, with amplified detail. It has a chapter on ship's magnetism and the compensation on the compass. It treats extensively of the electric field, the theory of potential, and electric oscillations and waves. Its final section is devoted to the electron theory, which in the table of contents is referred to, by an unfortunate typographical error, as the "election theory." The authors are experienced in the writing of school texts, and their work is sound, well-planned, and adapted to inspire and energize the immature intellect.

ADVERTISING. Selling the Consumer. By John Lee Mahin. Published by Doubleday, Page & Co. for the Associated Advertising Clubs of the World. 1914. 12 mo.; 260 pp.; illustrated. Price, $2 net.

In so often encountering the phrase "It pays to advertise," we are prone to overlook the fact that nothing is more costly, more wasteful, than ignorant and indiscriminate advertising. Advertising is an art and a science, as no one knows better than Mr. Mahin, and few are better qualified to impart its principles and its technique. His book admirably covers the general field. It sketches the present status of the science and states its fundamental problems. It shows exactly how markets benefit both producer and consumer, and how salesmanship is related to advertising. The fact is clearly elucidated that buyers may be divided into groups according to their incomes, and that the important question is how to reach the required group. The tools of advertising, its mediums, and the tests of its merits are convincingly discussed, and the various forms, retail, mail-order, and national, are separately handled. Many other phases of the subject are touched upon in the closing chapters, and so concrete is the information offered, so practical all the teachings and advice, that in reading the volume one seems to have his finger upon the very pulse of trade.

MODERNE NATURPHILOSOPHIE. Von Wilhelm Ostwald. Leipzig: Akademische Verlagsgesellschaft, 1914.

More than ten years have passed since Prof. Ostwald published his lectures on natural philosophy, which created a profound impression at the time. It is but natural that since their publication the author's views should have undergone some change. Moreover, scientific advances have also been made within the last decade which could not be ignored in an attempt to whip our modern scientific philosophical conceptions into a natural philosophy such as that with which our forefathers were familiar. Indeed, the whole scheme of presenting a modern natural philosophy has so far developed, that this new work promises to be the first of a whole series of three volumes. In this first volume Prof. Ostwald discusses the modern concepts of logic and mathematics. In other words, concepts which have nothing whatever to do with energy, as such, and which he places under the term "Ordnungswissenschaften." Prof. Ostwald regards logic as the first and most general science, and the greater part of his lectures is devoted to driving home that truth. Prof. Ostwald is probably one of the best men living to write a work on modern philosophy. A distinguished scientist who has made valuable contributions to chemistry in his day, an intellect which has almost dominated certain phases of modern German scientific thought, his work bids fair to form the basis of a whole literature which is intended to link science with philosophy.

A Suggestion in Patent Reform

THE objections to our patent procedure lies not so much in the organic law as in the methods of enforcement of the contract between the Government and the individual. In the development of our system it has suffered from the same practices that have received public disapproval in ordinary court procedure. Legal technicalities have supplanted in importance the economic aspects of a case, and legal form and procedure have almost attained the dignity of an end instead of a means.

The abuses which have thus found their inception and growth in the practice of adjudicating patent rights have led to the suggestion of a special court of patent appeals with revised rules of procedure and power of final decision. Even this excellent suggestion, however, concerns itself with improvement in the system *after* the patent has been granted, and offers no relief from obvious deficiencies in the system prior to and including the actual grant. The point is that probably much of the trouble now following the grant of a patent might be obviated by greater care in the granting.

Under present conditions a metallurgical or chemical patent in litigation has not received the careful attention of experts until it is called in question. Then it becomes the subject of a long investigation, and expert testimony is brought forward in great volume. The question arises: If experts are deemed necessary to settle a point in litigation, might they not be of equal value in passing scientifically on applications for patent? If, instead of submitting a patent to experts after it has been granted, it were subjected to scientific examination before granting, the prospective patentee might be relieved of much expense, delay and trouble, and would not feel that he had been deceived as to nature and value of the covenant between himself and the Government. Hoover comments on this phase of the matter in his book on Concentration by Flotation, saying that "if courts deprive him (the patentee) of the benefits definitely promised, someone has blundered. Every legal case in which the patents of one litigant are declared invalid is an indictment of the most serious nature against the system."

Another benefit that might result from scientific examination of patent applications would be the rejection of many supposed novel ideas of alleged usefulness. Many of these are scientifically unsound and claim results that are practically impossible of achievement. They merely clutter the record. Others contain alleged improvements and are often introduced by patent pirates and leeches. It is recognized, of course, as Hoover says, that "a new metallurgical process never springs fully developed from the brain of one person," and consequently many of the improvements are valuable. On the other hand, one has only to review the patents and litigation in one subject, such as flotation, to feel that if scientific experts reviewed the applications, many of them might not be granted. The situation would be freer from complications and progress in the industry would not suffer.—*Metallurgical and Chemical Engineering.*

New Use for Cocoanut Water

THE discovery has just been made at Colombo that cocoanut water, which has always been considered a useless waste product, is an excellent rubber coagulant. Millions of gallons of cocoanut water allowed to run to waste on estates can now be made use of at a good profit.

The cocoanut water is allowed to ferment for four or five days, after which it can be used without further delay as coagulating latex. One to two ounces of the fermented cocoanut water is allowed to coagulate one pint of the pure latex.

This is said to produce a fine rubber, superior to that procured with the use of crude acetic acid. The color of the rubber with acetic acid fermentation is decidedly inferior to the cocoanut water fermentation.

Cocoanut water is now made up in bulk

and shipped in large quantities from cocoanut plantations to the various rubber estates.

The Heavens in May

(*Concluded from page 407.*)

this effect; Venus is nearly twice the diameter of Mars, only 60 per cent of his distance from us, and almost twice as near the Sun, and her surface reflects about three times as much light from each square mile as that of Mars. Jupiter is a morning star in Pisces, rising about 2 A. M. Saturn is still an evening star, and is in conjunction with Mercury on the 31st. Mercury will be 2½ degrees to the north of Saturn and a little the fainter of the two. This will be an excellent opportunity to compare the two planets. Uranus is in quadrature east of the Sun on the 6th, and comes to the meridian at 6 A. M. Neptune is on the borders of Gemini and Cancer, and is observable (telescopically) until 10 P. M.

The Moon is in her last quarter a few minutes after midnight early in the morning of the 6th; she is new at 11 P. M. on the 13th; in her first quarter just before midnight on the evening of the 21st; and is full at 5 P. M. on the 28th.

She is nearest us on the 28th, and farthest away on the 14th. During the month she passes near Uranus on the 6th, Jupiter on the 8th, Venus and Mars on the 11th, Mercury on the 16th, Saturn on the 17th, and Neptune on the 19th. None of the visible conjunctions is close.

Mellish's Comet (1915a)

Reliable elements of this comet are now available, computed at the University of California from observations extending over more than a month. They show that its perihelion passage will occur on July 17th, at a distance almost exactly equal to that of the Earth from the Sun at the same time.

At this date, however, and for some time previously, it will be so far south in the heavens that we cannot see it at all; indeed, we will lose sight of it in the present month.

Its predicted positions are as follows for 7 P. M. Eastern standard time:

April 30th ..	18h.	43.9m.	—10° 46′
May 8th ...	18h.	51.2m.	—16° 28′
May 16th ...	19h.	14.7m.	—25° 23′
May 24th ...	19h.	43 m.	—39° 24′

On the first of these dates it is 82 million miles from the Earth, and on the last but 42 million, and it is also approaching the Sun, so that it is not surprising that its computed brightness increases nearly six-fold during this short time.

Its track runs through the eastern part of Sagittarius, about 10 degrees east of the "Milk Dipper," and, as the Moon will be out of the way the comet should be easily visible with a field-glass. The best time to look for it will be about 1 A. M.

During the early part of June this comet may be a fine object for southern observers as it will come within about 35 million miles of the Earth. It will be at its brightest about June 10th, when it will pass right over the smaller Magellanic cloud, and be a southern circumpolar object.

As it recedes from the Sun its orbit is roughly parallel with the neighboring part of the Earth's so that the Earth follows it for some time at a gradually increasing distance. It will probably be easily visible to southern observers for many months to come, and will probably become telescopically observable again in northern latitudes before it fades away in the distance.

Princeton University Observatory.

Variation of Eta Aquilæ

IN a note on this short-period variable published in *Astronomische Nachrichten*, M. Fessenkoff endeavors to explain its variation. In 1895 Belopolsky announced that the star has a satellite whose period coincides exactly with that of the star's variation in brightness. The orbit of the satellite has been determined by Wright. As the line of sight from our system does not lie in the plane of this orbit, the star's variation is not due to mutual eclipses, but rather to variations in the amount of surface presented to us, depending upon deformations in the two bodies under the marked tidal effects of their close proximity to each other. They may, in fact, be so close as to partially coalesce at the time of periastron. A secondary cause of variation, affecting the color as well as the brightness of the stars, would be, on this hypothesis, the varying thickness of the atmospheres surrounding the stars, due to variations in the surface area of the bodies, with corresponding variations in the amount of light absorbed.

In the Trenches*

AT first there were grumblers who scorned trenches. The veterans of the Revolution, who had been fighting all over Europe during fifteen years and who delighted in pitched battles, refused to burrow in the earth like moles. They loved to fight, but not to fight underground, and they gave a practical demonstration of this repugnance when they encountered the trenches which Wellington improvised at Torres Vedras for the defence of Lisbon.

The entrenchments at Torres Vedras resembled, on a small scale, those now employed by the Germans. They comprised two lines, one extending from the Zizambro River to the Tagus, a distance of 30 miles, the other somewhat shorter and 7 or 8 miles toward the rear. The construction of these entrenchments required the labor of 25,000 men during one month. They were well built and protected by pitfalls, *chevaux-de-frise* and other obstructions. The trenches which sheltered the soldiers were 16 feet wide and protected by parapets 10 feet in thickness. Each section was provided with casks of drinking water, a toolhouse and a magazine.

The memoirs of Masséna, who commanded the French army, describe various attempts made to draw the enemy out of this formidable position, which Thiébault calls a second Gibraltar. Wellington would not make a sortie. The French had no artillery heavy enough to attack the trenches effectively, and had only enough ammunition for one day of hard fighting. The only thing left was to besiege the enemy to the point of exhaustion, but this did not please the veterans of Jena, who regarded this imprisonment of the enemy as dishonorable and an imitation of their tactics as cowardly. The soldiers grumbled on being set to work digging trenches, and the officers showed their discontent so plainly that Masséna was compelled to order a retreat.

The second experience in underground warfare came at the siege of Sebastopol, in 1855. The investment of this supposedly impregnable stronghold absolutely required these tactics, but the French soldiers liked them no better than their ancestors had liked them 45 years earlier.

A volume of letters written to his family by Paul Goedorp, a lieutenant of Zouaves, during the Crimean war, has just been published. The writer was fresh from Saint Cyr and less than nineteen years old. Naturally brave, he feared neither peril, privation, nor fatigue, but his first turn in the trenches disgusted him. Higher officers were no more enthusiastic. Gen. Bosquet wrote: "This business will hereafter seem impossible; the most seasoned troops will certainly be worn out at the end of the campaign." Marshal Niel recognized that this sapper and miner warfare was depressing to French soldiers. "Fighting in the open air and sunlight," he says, "seems like a pastime in comparison with this working in the bowels of the earth, and its accompanying dangers."

Lieut. Goedorp accustomed himself to the situation, but not without effort, as his letters show, despite their cheerful tone. After his first turn in the trenches he writes that he is "horribly fatigued by a night on guard and two sleepless days." He explains by adding: "We start for the trenches at ten o'clock and return at three on the second day following, making two days and two nights in all. We enter

* An abstract from an article by G. Lenotre in *Le Temps*.

the trench, follow the wall for a long distance, and halt until night, when we are placed in a barely finished section within two hundred yards of a Russian battery."

Later he writes: "All day long I have amused myself in watching the destruction of the Russian guns by our shells. I shuddered a little on seeing dismembered corpses tossed into the air, but this will not effect me when I return to the trenches." This inhumation at intervals of three days is "nothing but dangerous drudgery." It was most tantalizing to see from the muddy trenches the Malakoff tower, which it would be so "amusing" to take by assault, but it was necessary to hide and dig in the earth until the artillery should have completed its task. What humiliation for a Zouave! Occasionally there is a note of ill humor: "At present we are doing absolutely nothing, except to go to the trenches, mount guard and dig. This sort of work is killing us. In one month the regiment has lost 700 men through death, wounds and fatigue. It is hard to have an average of 50 men *hors de combat* for each trench. A fine regiment like ours is being destroyed in a very foolish manner. To be killed in a trench, what a glorious fate!"

It was maddening to see, so near, the forts which the Zouaves would annihilate so easily if they were only "let go." "I thought I was coming to a grand festival, but I have been doing siege duty for four months. The impetuous young lieutenant condemns as incompetent, almost as criminal, the artillery and engineer officers responsible for the delay."

It was fated that he should not take part in the "grand festival." A week before the assault that he had longed for was made, he was struck by a shell splinter and died without having had the good fortune to fight "with bared heart, face to face with the enemy," as he had so often dreamed of doing.

War Capacity of United States Railways

By Dr. Robert Grimshaw

TWO salient features enter into railway capacity for war: first, rolling stock; second, track and yard limitations in a given theater of operations. The latter, being dependent upon the local conditions of any given theater of operations, will not be discussed here.

Concerning rolling stock, the equipment of our railways is ample for the assembling of units at their rendezvous or home stations, and for assembling divisions at their places of concentration; this without overtaxing the resources of our various commercial lines.

Concerning the concentration of divisions into field armies for operations in any possible theater of operations on our coasts or borders, by simultaneous large scale movements, the problem becomes more complicated, but, on the basis of our present war plan strength, still remains within the "capacity" of our commercial lines.

Tables I, II, and III, herewith, present data for reference in connection with the capacity of our railways for movements of troops.

Paragraph 393, Field Service Regulations, United States Army, 1914, gives the details of entraining; and reference thereto will show that the weights of equipments carried by infantry soldiers, etc., are not factors used in arranging railway movements of troops. Arms and equipments carried by individuals are customarily taken with them upon the cars; while wagons, animals, ammunition, rations and other impedimenta, usually carried by wagons when on the march, are loaded prior to the entraining of the men. The following factors are used in determining car and train section capacities:

(1) A train section usually consists, exclusive of engine and tender, of not more than 17 cars, total weight not over 700 tons; the weight of loaded cars being taken as: flat 25, box 27, stock 25, passenger and baggage 50, Pullman 55.

(2) Car capacities: tourist sleepers, 42 men.

Coaches, 45 men (3 men to each two seats); stock cars, 20 to 22 animals.

Box freight cars, 20 to 30 tons, dependent on bulk.

Flat cars:

(*a*) One gun, two caissons, field artillery.

(*b*) Three caissons, field artillery.

(*c*) Two caissons and one battery or store wagon, field artillery.

(*d*) One gun, one caisson, heavy artillery.

(*e*) Two guns, heavy artillery.

(*f*) Three caissons, heavy artillery.

(*g*) Three wagons, field ammunition or supply; or three ambulances—set up.

(*h*) One ponton on its wagon.

(*i*) Forty-eight wagon bodies, knocked down; or thirty-six if tunnels are met.

(*k*) Six ambulances, knocked down, tops not removed.

(*l*) Thirty tons freight.

The following table shows the cars required per unit of organization:

TABLE I.

	Personnel, etc.				Cars Required.						
	Men	Animals	Vehicles	Guns (vehicles)	Pullman or Tourist	Coaches	Baggage (kitchen)	Box	Stock	Flat	Total Cars
Infantry Regiment	1,915	171	22	..	5	43	6	5	11	8	78
Cavalry Regiment	1,308	1,435	26	..	8	29	9	8	67	9	130
Artillery Regiment (field)	1,198	1,154	104	24	9	23	9	9	56	45	151
Artillery Regiment (horse)	1,198	1,568	107	24	10	24	10	9	78	46	177
Artillery Regiment (heavy)	1,286	1,346	107	24	10	27	10	9	68	54	178
Artillery Reg'mt (mountain)	1,165	1,186	...	..	7	23	8	14	60	..	112
Batallion Engineers (Inf.)	514	165	12	..	2	12	2	4	8	4	32
Batallion Engineers (Cav.)	288	370	11	..	2	7	2	4	19	4	38
Batallion Signal Corps (Inf.)	176	202	15	..	2	4	2	2	10	5	25
Batallion Signal Corps (Cav.)	176	204	11	..	2	4	2	2	10	4	24
Divisional Trains (Inf.)	1,008	1,936	387	..	11	16	11	36	97	18	189
Divisional Trains (Cav.)	609	1,313	161	..	7	10	7	17	65	10	116

The above table shows the cars normally required by the different units of a large force, such as a field army, excepting ponton battalions, aero squadrons, and the headquarters of brigades and divisions.

In compiling the table, the divisional trains of both the cavalry and infantry divisions were assumed "knocked down," all other vehicles being shipped "set up"; and a reasonable regard was given to keeping units together in convenient train sections, without separating the troops of any unit from their animals and material.

Can our roads handle such masses of men and material? We can judge this from Table II, which shows the rolling stock of the principal railway systems of the United States east of the Mississippi River (Poor's Railway Manual, 1914), and from Table III, a memorandum of the cars required for an American field army, composed of units in normal proportions.

All the foregoing data are official, and were furnished by an officer of the regular Army.

TABLE II.

	Locomotives.	Cars.					
		Passenger.	Baggage	Box	Stock	Flat	Total
Penn'a R. R. System	7,033	4,277	706	84,576	4,229	5,419	99,207
N. Y. C. R. R. System	4,413	3,723		67,863	2,106	10,871	84,563
So. Ry. & N. & W.	1,501	338	223	18,049	2,328	2,878	24,058
		232					
Seaboard & Atlantic Coast Lines	1,162	497	249	31,374	158	8,252	40,530
B. & O. and C. & O.	2,579	834	317	40,127	400	2,943	44,621
I. C., C. N. O. & T. P.	1,700	581	193	32,090	1,047	3,369	37,280
Totals	18,388	6,527	1,698	274,079	10,268	33,732	330,259
		3,955					

TABLE III.

	Passenger	Baggage	Box	Stock	Flat	Total
27 Regiments Infantry	1,296	162	135	297	216	2,106
9 Regiments Cavalry	333	81	72	603	81	1,170
6 Regiments Field Artillery	192	54	54	336	270	906
1 Regiment Heavy Artillery	37	10	9	68	54	178
1 Regiment Horse Artillery	34	10	9	78	46	177
1 Regiment Mountain Artillery	30	8	14	60	.....	112
4 Battalions Engineers (Inf. Div., etc.)	56	8	16	32	16	128
1 Battalion Engineers (Cavalry)	9	2	4	19	4	38
4 Battalions Signal Troops (Inf. etc.)	24	8	8	40	20	100
1 Battalion Signal Troops (Cavalry)	6	2	2	10	4	24
3 Divisional Trains (Infantry)	81	33	108	291	54	567
1 Divisional Train (Cavalry)	17	7	17	65	10	116
Totals, 363 Locomotives and	2,115	385	448	1,899	775	5,622

Statistics of Baseball

By Arthur Macdonald

IF everything which takes place in the game were recorded, we might have proper statistics of baseball. A few data in addition to the official records have been gathered.

It is estimated that approximately 20 per cent of balls batted fair result in safe hits.

Of 10,074 batted balls, 3,602 or 20 per cent were fly balls; 5,171 or 51 per cent were grounders; 344 or 3 per cent bunts; and 957 or 9 per cent were line drives. Out of these 10,074 batted balls, 2,067 or 20 per cent were scored as base hits. Of the 3,602 fly balls, 741 or 20 per cent fell safe, and only 18 or 4/10ths per cent were muffed, showing practically that the major league fielders catch almost every ball they can reach.

Of the 5,171 ground balls, 424 or 8 per cent were scored hits. Of the 344 bunts, 155 or 45 per cent were safe, and of these 155, 114 or 74 per cent were handled by the fielders. Out of the 957 line drives, 741 or 77 per cent were safe, showing this to be the best kind of ball to knock.

In a number of games (not given), 72 plain hit and run signals were detected; 11 of these attempts, or 15 per cent, resulted in clean hits, 8 of which, or 11 per cent, enabled the runners to take extra bases; 27 of the attempts, or 40 per cent, advanced runners at the expense of retiring the batter at first base; 7 or 9 per cent resulted in batter striking out, and 3 of these strike-outs or 4 per cent resulted in the runner being doubled with the batter, while 2 of the strike-outs or 3 per

cent resulted in the runner reaching second.

Seventeen runners, or 23 per cent, were forced to second with no gain; 3 (4 per cent) were doubled on line drives, and 7 (9 per cent) of the batters flied out. The hit and run play succeeded in its object 50 out of 70 times, or 69 per cent.

Sacrifice hits average about one-third more than stolen bases, and the hit and run play occurs 60 per cent oftener than stealing bases. Table 1 gives some averages of the major leagues for five seasons:

TABLE 1.

Averages of Major Leagues (five seasons).

89,156 batters:
- 27,058 (30 per cent) reach first base.
- 17,138 (19 per cent) reach second base.
- 19,154 (21 per cent) reach first base on safe hits.
- 12,882 (14 per cent) reach third base.
- 8,272 (9 per cent) score.
- 1,303 (1 per cent) reach first base on errors,
- 5,956 (6 per cent) reach bases on balls.

2,744 (3 per cent) stolen bases:
- 1,951 (71 per cent) are stolen at second base.
- 774 (28 per cent) are stolen at third base.
- 19 (1 per cent) are stolen at home.

The best test of a player is, of course, his playing. But when players are somewhat equal and managers desire to select new men, the following anthropological data might be of service:

Name, age, color of hair and eyes, date and place of birth.
Height, sitting height, arm reach, and weight.
Length of arm and forearm, length, width and strength of hand and finger.
Circumference and depth of chest, and lung capacity.
Pulse, respiration, temperature.
Keenness of vision and accuracy of aim.
Nationality of father and mother, former occupation, education.

Most of the measurements here suggested are important ones in anthropology. Length of arm and forearm and length and width of hand and fingers might yield knowledge as to throwing and pitching. Thus, long, strong fingers are considered advantageous for pitchers. Also keenness of vision and accuracy of aim are worthy of consideration, especially for batting. Other data might be added, but those mentioned are sufficient to indicate plan of scientific study of the player himself.

It is often said that it is the little things which win the game. It may be true, therefore, that the anthropological knowledge here sought would furnish points instructive not only to the manager in choosing and comprehending his players, but in helping the player to understand himself better.

For instance, if the length of arm and forearm, length, width, and strength of hands and fingers of players were recorded, some practical knowledge as to pitching and throwing qualifications might be gained. Thus it is said that Mathewson's strength of hand or fingers is an important factor in his success with curves.

The question of a long body (sitting height) might prove of value, for such individuals are frequently strong, heavy, and fast runners; especially as to running and general staying qualities, the chest measurements, lung capacity, pulse, and respiration should be studied carefully.

TABLE 2.

Stature in Relation to Batting and Fielding.

Data concerning 140 leading baseball players, designated by the *Baseball Magazine:*

	No.	Per Cent.
Players 5 feet 11 inches or more in height	69	100
Batting average 250 or more	30	43
Batting average less than 250	39	57
Fielding average 950 or more	40	58
Fielding average less than 950	29	42
Those who bat and throw left-handed	3	4
	No.	Per Cent.
Players less than 5 feet 11 inches in height	71	100
Batting average 250 or more	44	62
Batting average less than 250	27	38
Fielding average 950 or more	47	66
Fielding average less than 950	24	34
Those who bat and throw left-handed	6	8

From an examination of this table (2) it will be seen that of the 140 leading major league players (designated as such by the *Baseball Magazine*), those who are less than 5 feet 11 inches in height are in general both better batters and fielders than those who are taller, and this superiority is greater in the batting than the

fielding. Nine (6 per cent) of these 140 players bat and throw left-handed, and six of them are of shorter stature.

Right and Left-handed Players.—In Table 3 are given a few figures comparing right and left-handed players. The figures are not, however, large enough to base conclusions upon, still they are suggestive and indicate the value of gathering data of anthropological nature of all professional baseball players. For with sufficiently large numbers important knowledge could be obtained.

From Table 3 it will be seen that 10 per cent of all the players throw left-handed, and 17 per cent bat left-handed and throw right-handed, and that 77 per cent of the latter are less than 5 feet 11 inches in height, or belong to those of shorter stature.

Pitchers Compared.—Table 4 gives some comparisons as to pitchers. Their number is relatively large (26 per cent). As will be noted, the pitchers are relatively tall men, 74 per cent of them being 5 feet 11 inches or more in height. Their batting average is very low, only 7 per cent having 250 or more.

TABLE 3.

Right and Left-handed Players.

	No.	Per Cent.
Total number of leading players	150	100
Those who throw left-handed	15	10
Those who throw right-handed	135	90
Those who bat left and throw right	27	17
Players who throw left-handed	15	100
Those 5 feet 11 inches or more in height	7	50
Those less than 5 feet 11 inches in height	7	50
Those with batting average 250 or more	6	40
Those with batting average less than 250	9	60
Those with fielding average 950 or more	8	53
Those with fielding average less than 950	7	47
	No.	**Per Cent.**
Players who throw right but bat left-handed	27	100
Those 5 feet 11 inches or more in height	6	23
Those less than 5 feet 11 inches in height	20	77
Those with batting average 250 or more	13	50
Those with batting average less than 250	13	50
Those with fielding average 950 or more	13	50

TABLE 4.

Pitchers.

	No.	Per Cent.
Total number of leading players	150	100
Number of pitchers	49	26
Remaining number of the players	101	74
Number of pitchers	49	100
Those 5 feet 11 inches or more in height	34	74
Those less than 5 feet 11 inches in height	12	26
Those with batting average 250 or more	7	14
Those with batting average less than 250	42	86
Those with fielding average 950 or more	24	49
Those with fielding average less than 950	25	51
Number of pitchers	49	100
Those who bat and pitch right-handed	35	76
Those who bat and pitch left-handed	9	20
Those who bat left and throw right-handed	1	2
Those who bat right and throw left-handed	1	2

TABLE 5.

Average Height and Weight of Players.

Leading baseball players, designated by the *Baseball Magazine:*

	No.	Average Height. Ft.	In.	Average Weight. Lbs.
All players	150	5	9 1/2	174
Right-handed	135	5	9 3/8	174
Left-handed	15	5	10 3/5	175
Pitchers	49	5	11 4/5	175
Right-handed	35	5	11 4/5	174
Left-handed		5	10 4/5	177
Players who bat left and throw right	27	5	9 7/10	170
Basemen	32	5	10 2/5	174
Outfielders	35	5	9 4/5	171
Catchers	18	5	10 2/5	178
Leading batters	13	5	10 3/5	175
Shortstops	11	5	9 2/5	167

Table 5 presents data as to average height and weight of 150 leading baseball players.

As already indicated, the figures are not large enough to serve more than in the way of suggestion. The catchers are the heaviest

(178 pounds) and the shortstops the lightest (167 pounds) in weight. Those left-handed are the heaviest both among the players in general (175 pounds), and in the case of the left-handed pitcher (177 pounds) as compared with those pitching right-handed (174 pounds).

Some apparent discrepancies are due to the fact that it was impossible to obtain figures in all cases.

As might be expected, the outfielders are lighter in weight (171 pounds) than the basemen (174 pounds).

Those who bat left and throw right-handed seem to be lighter in weight (170 pounds) than the average (174 pounds).

It is evident that the leading players of the highest class would have excellent physical and symmetrical development, as indicated by the figures for heights and weights in the table. Differences, therefore, between their measurements have more significance than if compared with ball players in general.

Proposed Statistics of Flies and Grounders.—In consulting with official scorers, I find that no systematic account is taken of flies and grounders, and so it is not possible to determine whether or not the clubs knocking the fewest flies and the largest number of grounders relative to the number of games are in general winners. Such data and many others not yet recorded, when carefully studied, might show a principle or general trend of law, which might change some of the rules, plays, and methods now in vogue.

Table 6 gives a *tentative* classification of flies and grounders which might be recorded:

TABLE 6.

Flies and Grounders.

High fly to right, center, or left infield, or outfield, or foul.

Long fly to right, center, or left infield, or outfield, or foul.

Line fly to right, center, or left infield, or outfield, or foul.

Sacrifice fly to right, center, or left infield, or outfield, or foul.

Pop fly to right, center, or left infield, or outfield, or foul.

Home run grounder to right, center, or left infield, or outfield.

Home run fly to right, center, or left infield, or outfield.

Home run line to right, center, or left infield, or outfield.

One, two, or three-base hits to right, center, or left infield, or outfield.

Swift grounders to right, center, or left infield, or outfield, or foul.

Slow grounders to right, center, or left infield, or outfield, or foul.

Grass cutters to right, center, or left infield, or outfield, or foul.

Chop balls to right, center, or left infield, or outfield, or foul.

Bunts to right, center, or left infield, or outfield, or foul.

If at the end of the season a player should find that he has been knocking more high flies, or undesirable kind of hits than he had any idea of, or that a large per cent of his bunts had failed of their purpose, such unexpected knowledge might help him to find the cause and apply the remedy.

In short, if we desire to determine more definitely the general laws of the game, most successful kind of plays and tricks and to what extent they should be followed, and to settle disputed questions, as already emphasized, everything that takes place in the game from beginning to end should be recorded.

It may seem to some that so many details would be useless, but in all scientific inquiry it is presumptuous to assume to know in advance what facts are important and what ones are not; only the omniscient can do that.

But it may be said that there is danger of making the game too exact to be interesting. There is, however, no probability of this, since at best, owing to the complexity and necessary chances of the game, there will always be a sufficient number of unexpected events to relieve the supposed scientific monotony.

TIME AND PLACE OF BIRTH OF MAJOR LEAGUE PLAYERS.

TABLE 7.

Time and Place of Birth.

Leading baseball players in the United States:	No.	Per Cent.
Total number selected.....	146	100
Those born in country.....	90	61
Those born in city.....	56	39
Those born in warmer months..	95	69
Those born in colder months....	51	31

In Table 7 are given the number and per cent of those major league players who were born in (1) the country and those born in the (2) city; also those born in the (3) warmer months, and those in (4) the colder months. By city is meant all towns of 30,000 or more inhabitants. All places less than 30,000 are counted as country. November, December, January, February, March, and April are the colder months, and May, June, July, August, September, and October the warmer months. It will be seen that 22 per cent more are born in the country and 38 per cent more in the warmer months. It has been established in Switzerland, that children born in summer are taller and heavier than children born in winter. It is generally believed that those living in the country are stronger and healthier than those living in cities. These facts as given in Table 7 for the players confirm the results of investigations as to the advantage of country life and being born in the warmer months. In the summer the mother and child are outdoors more, and food is cheaper and better. But, it may be asked, are not more children in the general population born in warm seasons than in cold seasons? The few statistics in this matter show there is no great difference, as indicated in Table 8, giving the number of births per 1,000 population for the colder and warmer months in Great Britain:

TABLE 8.
Birth Rate in Great Britain.

	1908	1909	1910
Birth rate in January, February, and March	25.9	25.9	24.8
Birth rate in April, May, and June	27.6	26.6	26.1
Birth rate in July, August, and September	26.3	25.1	24.7
Birth rate in October, November, and December	24.4	24.2	23.3

Anthropology Fundamental.—The importance of anthropological data in the investigation of all classes of men is fundamental, whether it be a study of normal or abnormal man, genius, insane, or criminal; talented man, congressional man, or baseball man, or any class of men; it is all *man*, and the method is practically the same. There must be a general criterion or measuring rod for estimating and understanding physical and mental superiority and distinguishing them from the average and the mediocre.

All, therefore, which will make baseball more scientific as well as more interesting will not only increase the financial receipts, but, what is better, still further encourage boys and young men to play the game more and more, and thereby find a pleasant way of developing sound bodies and sound minds, which will make them better citizens.—*Abstracted from American Physical Education Review.*

German War Diet for Horses

THE German government has restricted the quantity of oats which may be given to a horse to 2½ to 3½ pounds daily, and German horse owners are afraid that this restriction will injuriously affect the health and usefulness of their animals. In a recent issue of the Berlin *Lokal Anzeiger*, Dr. Klingner, city veterinary, shows that these fears are groundless. His experiments, carried on during many years with large numbers of horses, convinced him that maize forms a very satisfactory substitute for oats. At present, however, maize is as scarce as oats, so that some other substitute must be found. The most obvious one is potatoes, which are very abundant and have been stored in great quantities by all German communities.

Potatoes differ from maize, chiefly in containing a little less starch and considerably less digestible albumen. The deficiency in starch can be met by increasing the ration, and the deficiency in albumen can be compensated by adding a small quantity of some food that is rich in albumen.

The change in diet must not be made too sudden, and the idiosyncrasies of individual horses must be considered. Most horses bear the change very well, but a few animals suffer from catarrh of the stomach or bowels. In such cases the

attending veterinary must prescribe the quantity of the new fodder to be given. The guiding principle in each stable should be to maintain the former rations of starch and albumen, despite the change in fodder.

Dr. Klingner has proved by experiment that the entire grain ration of horses can safely be replaced by potato flakes or steamed fresh potatoes, if a sufficient quantity of good hay or chopped straw is given also. Other farm animals bear the deprivation of grain even better than horses do, and Dr. Klingner expects permanent advantages to flow from successful experience with the war diet which is now enforced temporarily.

The Discovery of Radium in Coal

A SERIES of remarkably interesting experiments have been recently carried out in the west of England by certain scientists to demonstrate the extraordinary effect on vegetable growth produced by the addition to the soil of radium-bearing and radio-active materials.

A full and instructive account of some of these experiments was given, some little time ago, in a lecture before the Royal Society of Arts by Mr. T. Thorne Baker.

It appears that radishes and other root crops are obtained nearly *five* times as large as those grown in untreated soil at the same time.

If this process could be generally adopted by our agriculturists in this country, the increase in the prosperity of the nation would be very large.

The initial cost of such a system has hitherto stood in the way of its general adoption.

But the recent discovery by M. M. Détaille and Lafayaise, the two distinguished French chemists of Paris, and Prof. Scammell, M.S.C.I., of Hadleigh, Essex, that coal contains radium, which, in the form of "lignaite," can be used for the radiumization of the soil, places the process within the reach of every agriculturist in the country.

Fruits, flowers, and vegetables can be grown in a much *shorter* time, in much larger quantities, and of finer quality by the use of "lignaite," the cost of the treatment of an ordinary sized garden being very trifling; the process is available for use by the humblest worshiper at the shrine of Flora.

Once more in the history of human progress the world is indebted to the brilliancy and originality of French scientific thought and research, and with a view to enable the country at large to benefit by their discoveries, the eminent chemists mentioned are sending to all applicants full details of the best methods of applying the "lignaite" to the soil.

The importance of this discovery to the small land owner or cultivator is obvious; it is now possible for the man with two or three acres of ground to make a substantial profit each year, sufficient to keep his family and himself in comfort.

And this discovery, viz., medicatrix natural, the latest and most beneficent of the achievements of science, goes far to solve the land problem and pave the way for the reappearance of the sturdy peasant proprietor, the backbone of the country.

An Organization for "Nova" Search

MR. W. H. STEAVENSON of the British Astronomical Association is organizing a section of that association which will devote itself to the task of keeping a lookout for new stars. Each member will be given a portion of the Milky Way, the size of which will depend largely upon the number of observers. He will make himself acquainted with every star in the area down to about magnitude 6.5, or lower if he has the time and inclination. As soon as he is familiar with this area, his work will consist simply in making a rapid survey of it at least once every fine night, if possible. It is hoped that members will also familiarize themselves with the stars in other parts of the Milky Way down to about magnitude 4.5, in order to increase the chances of the prompt discovery of novæ in areas whose

regular observers are prevented from making their nightly survey, by cloudy weather or otherwise.

The Danger of Delay in Cancer

THOUSANDS of lives now needlessly sacrificed to cancer could be saved if the patient would go to the surgeon as promptly as does the average person attacked by appendicitis. Nor is there any reason why the cancer patient should not seek this, the only safe treatment, with the same high degree of confidence in the outcome that is now common among those suffering from the other more fashionable disease. Unfortunately, the evidence is only too clear that a different attitude toward cancer prevails and occasions many preventable deaths. The almost superstitious dread of the disease and unwillingness to admit its existence or to seek medical advice in time are well known and difficult obstacles to progress in its control. Proof of this fatal neglect is found in the experience of a prominent surgeon who recently studied his case records in order to obtain definite information as to the delay in the average case. Of sixty-five recent patients, thirty-five were men and thirty were women. Further study of these sixty-five cases showed that after the first discovery of suspicious symptoms the men had waited an average of 12.2 months before consulting the doctor, and the women had waited, on the average, 11.9 months, practically a year's delay in all cases. Many other surgeons could produce very similar records. Winter, of Koenigsberg, Prussia, the pioneer in the education of the public in regard to cancer, examined the records of 1,062 operable cases and showed that 87 per cent of these patients could and should have applied for treatment much earlier, when they would have had a far higher chance of recovery than was actually the case.

To the delay when the symptoms are manifest must be added the previous indefinite period after the beginning of the disease and before the patient realizes the trouble. This period can be shortened by education. Fortunately, the symptoms of cancer are present rather early and can usually be recognized if the patient understands their importance. In too many instances, however, the disease is not suspected until the symptoms are pronounced or until there is a tumor of considerable size. If we assume that this period averages six months, and then add the year's delay for which the patient is responsible, we find that the average patient does not seek advice until at least a year and a half after the onset of cancer. This precious time, thrown away, means, if not a fatal outcome, at least a serious instead of a minor operation.

In the present state of our knowledge of malignant disease it cannot be too frequently emphasized that the hope of curing cancer is to be found in its earlier recognition and in prompt and competent surgical treatment. The unfortunate patient who, because of ignorance or unwarranted fear or the blandishments of quacks, hesitates to seek proper advice should realize that in this delay he or she is recklessly throwing away a splendid chance of cure.

"The Moon is a Dead Planet"

IS this common statement true? A long discussion was precipitated at a recent meeting of the British Astronomical Association by an article published by Prof. W. H. Pickering in the November, 1914, number of *Popular Astronomy*, in which the writer appeals to astronomers—and especially amateurs, because "scarcely any professional astronomers look at the moon nowadays" to report their observations of apparent changes on the moon, so that "we shall at length nail that ancient falsehood that 'the moon is a dead planet.'" Prof. Pickering began asserting the existence of vegetation on the moon more than twenty years ago, and has been writing on this subject at frequent intervals ever since. The same idea had been favored by certain earlier astronomers, notably by Sir William Herschel. Yet the unqualified statement as to the complete lifelessness of our satellite is repeated in almost every new book on astronomy. The subject is still a moot one, and the discussion above mentioned indicates that few members of the British Astronomical Association share Prof. Pickering's views. The latter astronomer publishes in the March, 1915, number of *Popular Astronomy* an article on "The Meteorology of the Moon," in which he details numerous observations of apparent patches of snow, ice, mist, etc., on the moon.

A New Explanation of Brontides

THE SCIENTIFIC AMERICAN SUPPLEMENT of January 18th, 1913, contained an account of the mysterious explosive sounds common in various parts of the world, and known under scores of names, the most familiar being *brontidi* (or *brontides*), *mistpoeffers*, and *Barisal* guns. The latest attempt to explain these phenomena (or some instances of them) is due to Wilhelm Krebs, who records the fact that the cannonading in the North Sea fight of January 24th and in the airship attack on the English coast, January 19th, was heard on the coast of Holland, the distance being of the order of 100 to 120 miles. Krebs invokes the Wegener hypothesis of a reflection of sound (i. e., an echo) from a surface of discontinuity supposed to exist in the upper atmosphere, some fifty miles above the earth. Although Wegener's hypothesis appears to be altogether fallacious, the mere fact that such remote cannonading was heard along a coast where mistpoeffers are often reported suggests that these sounds may frequently be due to ordinary explosions, such as blasting operations, target practice of warships, and the like, under atmospheric conditions insuring audibility at a greater distance than usual. It appears that the fisher-folk on the Flemish coast are in the habit of saying, when mistpoeffers are heard, "They're shooting in England," which may be an accurate statement.

Some Adjudicated Patents.—The Mygatt design patent No. 37,967 for a prismatic glass reflector has been held valid and infringed in Mygatt v. Schaffer 218 Fed. Rep. 827 while in the suit between the same parties the Mygatt patent No. 40,182 for a design for prismatic glass reflector has been held void for anticipation by design patent No. 40,140 to the same inventor. The Watson patent No. 559,642 for corrugated metal culvert has been held valid and infringed in Stillwell v. McPherson 218 Fed. Rep. 839; the Smith patent No. 692,935 for a weft replenishing mechanism for looms was held void for anticipation in Crompton & Knowles Loom Works v. Stafford Company 218 Fed. Rep. 841; the Mygatt patent No. 939,062 for an integral shade-reflector of glass held void and infringed in Mygatt v. Schaffer 218 Fed. Rep. 827; in Karl Keifer Machine Company v. Unionwerke A. G. 218 Fed. Rep. 847 the Keifer reissue patent No. 12,455 (original No. 797,122) for a filter pulp packing machine for pressing filter cake for beer filters was held valid but not infringed; the Keifer patent No. 993,780 for a filter claim 1 was held valid but not infringed; the Keifer patent No. 1,015,326 claims 14 to 17 inclusive for a filter were held void for insufficient description and want of statutory affidavit and claims 23 to 25 inclusive for a filter cake held void for lack of novelty and the Keifer patent No. 1,023,254 for a filter for straining beer was held void for lack of novelty in view of the prior art.

"Manufacture" and Range of Equivalents.—In Thacher v. City of Baltimore 219 Fed. Rep. 909 the court held that an arch of a bridge or like structure is a "manufacture" within the meaning of the patent law; also that, however limited the range of equivalents to which a patent is entitled, equivalency must be commensurate with the extent of the invention; also held the Thacher patent No. 617,615 for a reinforced concrete arch valid and infringed.

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